THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXVI. No. 20 Whole No. 1,145. | NEW YORK, MONDAY, MAY 17, 1897. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Twentieth Annual Meeting, Western Gas Association..... 757

EDITORIALS—
Briefly Told..... 758
Mr. Monroe's Paper on "Incandescent Lamp Efficiency"—Mr. Loomis and the Gas Supply of Connecticut—Notes.

*Locating, Determining and Laying of Street Mains and the Distribution of Gas, No. III., by Mr. J. P. Gill..... 758

Proceedings Third Annual Meeting, Texas Gas and Electric Light Association—Official Report—Revised by the Secretary—Continued from page 728..... 759
First Day, Afternoon Session—Address of Mayor Callaghan—Remarks by Mr. Holmes—Remarks by Mr. Eaton—"Incandescent Lamp Efficiency: Its Importance to Central Stations, by Mr. H. L. Monroe, of Dallas—Discussion—Little Things, by Mr. W. E. Holmes, of Austin.

The Utilization of Fuels, No. II., by "R."..... 765

*A Practical Illustration of the Working of a Large Gas Engine, by Mr. E. F. Lloyd..... 767

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 768
Mr. Rathell Goes to Decatur, Ills.—Annual Meeting, Hanover, Pa.—Improvements on the Fitchburg (Mass.) Works—New Offices for the Independence (Mo.) Company—A Hint from Windsor, Ont.—A Lighting Company for Dodge City, Kansas—Death of Mr. P. M. Papin—Annual Election, Cincinnati, O.—Annual Meeting, South Side Co., Pittsburg, Pa.—Mr. A. M. Barnes Succeeds the Late Mr Vogl—Changes at Catasauqua, Pa.—Resolutions to the Memory of the Late Mr. Spaulding—Mr. E. R. Spaulding Succeeds His Father—Annual Meeting, Putnam, Conn.—Something from Windsor, Ont.—Contracts for the Parker-Russell Company—Annual Meeting, Coatesville, Pa.—New Holder for the Pawtucket (R. I.) Company—Annual Meeting, Providence, Pa.—New Holder for the Fall River (Mass.) Company—An Interesting Decision—Personal—Something from Gas Inspector Meed's Report—And Other Items.

A New Gas Engine Cycle..... 770

The Market for Gas Securities..... 770

[OFFICIAL NOTICE.]

Twentieth Annual Meeting, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
NEW ALBANY, IND., April 13th, 1897.

The 20th annual meeting of the Western Gas Association will be held at Cincinnati, O., May 19th, 20th and 21st, 1897, and will be called to order by the President, Mr. W. H. Odiorne, at 10 A.M., Wednesday, May 19th.

The meeting of the Board of Directors will be held at 10 A.M., Tuesday, May 18th. The following are Directors: Messrs. A. W. Littleton, Geo. H. Harper, Peter Young, Wm. Steinwedell, O. O. Thwing, I. C. Copley, C. W. Blodget, H. W. Douglas, James Forbes.

The Grand Hotel has been selected as the headquarters for the members, and the sessions of the Association will be held in a suitable room contained therein. A rate of $3 per day, American plan, has been obtained; rooms with bath, extra. Those who desire cheaper rates can obtain them at the Palace Hotel, located on Vine and Sixth streets; rates, $2 to $2.50 per day; or at the Hotel Emery, European plan only, rooms, $1, $1.25 and $2 per day. It is advisable that all write and reserve their rooms in advance of the meeting.

The Executive Committee have arranged for the presentation of the following papers:

"Revivification of Oxide of Iron in Purifiers," by Mr. I. C. Baxter, Detroit, Mich.

"The Failure of the Commercial Attempts to Supply Fuel Gas in the United States," by Mr. F. H. Shelton, Chicago, Ills.

"Selling Gas," by Mr. I. C. Copley, Aurora, Ills.

"Leakage," by Mr. E. H. Jenkins, Covington, Ky.

"An Oil-Tar Separator and Its Results," by Mr. John R. Lynn, Detroit, Mich.

"The Welsbach Incandescent Gas Light for Utility and Economy in Street Lighting," by Mr. H. Wilkiemeyer, Evansville, Ind.

"Wrinkle Department," edited by Mr. Geo. Treadway Thompson, New York.

Mr. F. Egner, who is now in Europe investigating inclined retorts, or "slopers," will send a communication giving the results of his investigations.

The Central Passenger Association, Trunk Line, Southern Passenger Association, and the Chicago and Alton, from all points in Illinois, have granted rates of 1½ fare for the round trip, conditional on 100 certificates being presented to the Secretary for indorsement. The territory embraced by the above Associations includes all States east of the Mississippi river, except New England, and Wisconsin.

All persons attending the meeting will purchase a first-class ticket at starting point, paying full fare for same, obtaining from agent a certificate stating that the person whose signature appears on same has purchased at full tariff fare one first-class ticket to Cincinnati, which certificate, after it has been signed by the Secretary of the Association and a representative of the above Passenger Associations, will entitle the purchaser thereof to a one-third rate returning home.

All persons obtaining reduced rates must apply to agent at least 30 minutes before departure of train. All station agents do not have a

supply of certificates, but they may be obtained by request, if notification is made in time. Persons outside the territory embraced by Passenger Associations mentioned above should purchase a ticket to nearest point within said Association, and from there purchase a ticket to Cincinnati, obtaining a certificate which will entitle them to a one third fare returning to place from which certificate was obtained.

All queries sent to the Secretary for the Question Box will be assigned to members for answers.

A cordial invitation is extended to members of other Associations to meet with us, and to participate in the discussions of papers presented.

The Secretary will be pleased to answer any communications pertaining to the meeting, and will mail blank applications to any who desire to become members of the Association.

JAMES W. DUNBAR, Secretary.

BRIEFLY TOLD.

MR. MONROE'S PAPER ON "INCANDESCENT LAMP EFFICIENCY."—In our current installment of the proceedings of the third annual meeting of the Texas Gas and Electric Light Association will be found the text of a paper read by Mr. H. L. Monroe, of Dallas, Tex., whose presentation of the subject of "Incandescent Lamp Efficiency: Its Importance to Central Stations," is well worth reading, for the author evidently saw fit to treat his theme from the standpoint of everyday practice, and to recite his results in like way. It is true that Mr. Monroe's findings are related to the incandescent electric lamp, and as such have no particular application to the troubles of gas men unincumbered with the operation of electric lighting annexes, but his story can nevertheless be appreciated by every gas maker who has struggled to convince an objecting gas consumer that the fault attributed by the latter to the gas supplied him was rather of the burner than in the gas. It is rare to find in electrical supplying an engineer who has the outspokenness of Mr. Monroe, and we venture to remark that if more of his co-laborers were imbued with his spirit, the profession in which they share would report smaller losses, even if not able to record greater profits. Mr. Monroe tells his story so cleverly that further dissection at our thought would add nothing to its teachings, which may profitably be applied by every supplier of electric currents for lighting.

MR. LOOMIS AND THE GAS SUPPLY OF CONNECTICUT.—Something over a month ago (to be precise about it, the date was April 5th), we had occasion to say that Mr. Loomis and his associates, in their appeal to the Connecticut Legislature for the right to supply "fuel" gas in Hartford, and virtually at other points in the same State, did not seem to have presented arguments to the Committee on Incorporations of the Connecticut Legislature sufficient to obtain a favorable report for their scheme. That the prediction was based on a fair sifting of the value of the evidence given seems to have been borne out by the action of the Committee and the endorsement of that action by both branches of Connecticut's Legislature. To sum the case and the verdict up in as few words as possible, the Committee, on May 7th, reported adversely to the petitioners, and, on May 12th, both branches of the Legislature sanctioned by ratification the adverse report. So that neither "if" nor "or" nor "but" might remain as solace or hope for Mr. Loomis and his coadjutors, the report of the Committee and the action of the Legislature were adopted without the recording of a single dissenting vote. Now, if Mr. Loomis and his party will only demonstrate that fuel gas, of itself, can be successfully made a "go" at Bridgeport—the Legislature has denied his petition for an amendment to the charter of the fuel gas company at Bridgeport, permitting the distribution by it also of illuminating gas—they will have put the whole gas fraternity under indebtedness to them.

NOTES.—In our obituary mention last week, respecting Mr. Elbridge Gerry Spaulding, we should have noted that deceased was the framer of the act, commonly known as the "General Gas Law" (enacted in 1848), under which 90 per cent. of the gas companies doing business in this State secured their incorporation.——The Consolidated Gas and Electric Company, of Batavia, N. Y., will put down over a mile of main pipe this season. A station meter will also be installed.——At the annual meeting of the Mutual Gas Company, of St. Johns, Mich., the following officers were chosen: Directors, Chas. Fowler, Geo. F. Marvin, John Corbit, Thos. Bromley, Jr., and E. L. Dooling; President, Chas. Fowler; Vice-President, Geo. F. Marvin; Secretary and Treasurer, Geo. A. Wells.——Write to Mr. Fred. Bredel, of Milwaukee, Wis., for a copy of his "All About Gas."

[Prepared for the JOURNAL.]

Locating, Determining and Laying of Street Mains and the Distribution of Gas.—No. III.

By MR. J. P. GILL.

By equation (B), $D^5 = \frac{.0000006s\ Q^2\ L}{H}$

$$(1)\ D^5 = \frac{.0000006 \times .5 \times (60{,}000)^2 \times 8{,}000}{1} = 8{,}640{,}000.$$

By referring to the table of 5th powers, it will be seen that this number occurs between the 5th powers of 24 and 30; therefore 30 inches must be taken as the right diameter of the pipe.

What will be the pressure at the end of the 900 yards at B?

By equation (C)—

$$(1')\ f = \frac{.0000006s\ Q^2\ L}{D^5} = \frac{.0000006 \times .5 \times (60{,}000)^2 \times 900}{24{,}300{,}000} = .04 \text{ inch.}$$

1 — .04 = .96 inch, the pressure at B.

As 8,000 cubic feet are used in districts (1), (5) and (9), 52,000 cubic feet will pass through the pipe from B to C‴, 7,100 yards long. What will be the diameter of the pipe between B and C, 1,800 yards long, and the pressure at C, with a pressure at B of .96 inch?

$$(2)\ D^5 = \frac{.0000006 \times .5 \times (52{,}000)^2 \times 7{,}100}{.96} = \frac{5{,}759{,}520}{.96} = 5{,}999{,}500,$$

requiring a 24-inch pipe.

$$(2')\ f = \frac{.0000006 \times .5 \times (52{,}000)^2 \times 1{,}800}{7{,}962{,}624} = 18 \text{ inch for loss of pressure by friction.}$$

.96 — .18 = .78 inch, pressure at C.

It is evident, on reflection, that the next larger diameter of pipe, as usually made, above the 5th root of the number found as above, should be taken for the diameter; for, if the next smaller diameter be taken, the loss of pressure by friction might be so great as to make the pressure at or near the end of the pipe entirely too small—even a minus quantity; or, in other words, the pressure required to force the requisite quantity of gas through the pipe might be so large as to make the loss by leakage excessive and might disarrange the whole scheme.

As an illustration, take the last example in which the diameter of the pipe was found to be 24 inches. If 20 inches had been taken, the loss by friction would have been as follows:

$$f = \frac{.0000006 \times .5 \times (52{,}000)^2 \times 1{,}800}{3{,}200{,}000} = .46 \text{ inch,}$$

and the pressure at C would be .96 — .46 = .50 of an inch, instead of .78 inch, only about two-thirds. As this would be the pressure at the beginning of the main supply pipe from C to C‴, this pipe would have to be larger than that the correct calculation gives, and that from C to D, and also the district supply pipes.

It will also be noticed that, in order to find the diameter of the pipe from A to B, the whole length of the main supply pipe from A to C‴ is used instead of the length from A to B, because if the smaller length had been used, the diameter would have been entirely too small; for instance: Take the last example, and make the length 1,800 yards instead of 7,100 yards—

$$D^5 = \frac{.0000006 \times .5 \times (52{,}000)^2 \times 1{,}800}{.96} = 1{,}521{,}000,$$

giving a 20-inch pipe instead of a 24-inch. The loss by friction would be

$$f = \frac{.0000006 \times .5 \times (52{,}000)^2 \times 1{,}800}{3{,}200{,}000} = .46 \text{ inch,}$$

making the pressure at C, .96 — .46 = 50 inch, instead of .78 inch, or about ⅔ as large, which would necessitate an increase in the sizes of the pipes throughout the town, or an increased pressure at C, with an increased leakage, etc.

Resuming the calculation at the point C, let it be required to find the diameters of the pipes between C and C‴, running through the districts (2), (3), (6), (7), (10) and (11), the consumption in which is 47,500 cubic feet per hour.

Q = 47,500, L = 5,300 yards, H = .78 inch.

$$(3)\ D^5 = \frac{.0000006 \times .5 \times (47{,}500)^2 \times 5{,}300}{.78} = 4{,}599{,}278,$$

requiring a 24-inch pipe.

$$(3')\ f = \frac{.0000006 \times .5 \times (47{,}500)^2 \times 900}{7{,}962{,}624} = .08 \text{ inch.}$$

.78 — .08 = .70 inch, the pressure at C′.

What will be the diameter of the pipe between C′ and C″, and the pressure at C″?

Here Q = 34,000 cubic feet consumed in numbers (6), (7), (10) and (11), L = 4,400 yards, H = .70 inch.

$$(4)\quad D^5 = \frac{.0000006 \times .5 \times (34{,}000)^2 \times 4{,}400}{.70} = 2{,}179{,}886,$$

requiring a 20-inch pipe.

$$(4')\quad f = \frac{.0000006 \times .5 \times (34{,}000)^2 \times 2{,}300}{3{,}200{,}000} = .25 \text{ inch.}$$

.70 — .25 = .45 inch, the pressure at C″.

What should be the diameter of the terminal pipe between C″ and C‴, and what will be the pressure at the end C‴?

Q = 13,000 cubic feet in (10) and (11), L = 2,100 yards, H = .45 inch.

$$(5)\quad D^5 = \frac{.0000006 \times .5 \times (13{,}000)^2 \times 2{,}100}{.45} = 236{,}600,$$

requiring a 12-inch pipe.

$$(5')\quad f = \frac{.0000006 \times .5 \times (13{,}000)^2 \times 2{,}100}{248{,}832} = .43 \text{ inch.}$$

.45 — .43 = .02 inch, the terminal pressure at C‴.

Returning to the point B, the beginning of the supply pipe to the districts (1), (5), (9), which have an hourly consumption of 8,000 cubic feet, and a pressure of .96 inch, and a length of 5,300 yards, what will be the diameters and pressures between B and B‴?

$$(6)\quad D^5 = \frac{.0000006 \times .5 \times (8{,}000)^2 \times 5{,}300}{.96} = 106{,}000,$$

requiring a 12-inch pipe between B and B′.

$$(6')\quad f = \frac{.0000006 \times .5 \times (8{,}000)^2 \times 900}{248{,}832} = .07 \text{ inch.}$$

.96 — .07 = .89 inch, the pressure at B′.

The quantity of the gas passing through the pipe from B′ to B″ is 4,500 cubic feet, and from B′ to B‴ is 4,400 yards. The pressure at B′ is .89 inch. The length from B′ to B″ is 2,300 yards. What should be the diameter of the pipe between B′ and B″, and the pressure at B″?

$$(7)\quad D^5 = \frac{.0000006 \times .5 \times (4{,}500)^2 \times 4{,}400}{.89} = 30{,}033,$$

requiring an 8-inch pipe.

$$(7')\quad f = \frac{.0000006 \times .5 \times (4{,}500)^2 \times 2{,}300}{32{,}768} = .43 \text{ inch.}$$

.89 — .43 = .46 inch, the pressure at B″.

Find the diameter of the pipe between B″ and B‴, and the terminal pressure at B′′.

$$(8)\quad D^5 = \frac{.0000006 \times .5 \times (1{,}500)^2 \times 2{,}100}{.46} = 3{,}082,$$

requiring a 6-inch pipe.

$$(8')\quad f = \frac{.0000006 \times .5 \times (1{,}500)^2 \times 2{,}100}{7{,}776} = .18 \text{ inch.}$$

.46 — .18 = .28 inch, the pressure at B‴.

This 6-inch pipe may be reduced by dividing the last length of 2,100 yards in two of 1,500 yards and 600 yards, furnishing, respectively, 1,000 cubic feet and 500 cubic feet.

$$(8'')\quad D^5 = \frac{.0000006 \times .5 \times (1{,}500)^2 \times 2{,}100}{.46} = 3{,}082,$$

requiring a 6-inch pipe as before.

$$f = \frac{.0000006 \times .5 \times (1{,}500)^2 \times 1{,}500}{7{,}776} = .13 \text{ inch.}$$

.46 — .13 = .33 inch, the pressure at end of the 1,500 yards at B″.

$$(8''')\quad D^5 = \frac{.0000006 \times .5 \times (500)^2 \times 600}{.33} = 136,$$

requiring a 3-inch pipe.

$$f = \frac{.0000006 \times .5 \times (500)^2 \times 600}{243} = .18 \text{ inch.}$$

.33 — .18 = .15 inch, the pressure at B‴.

This last arrangement may be varied as to quantities and lengths at pleasure, never allowing the pressure at B‴ to fall to zero. If there are any probable extensions in view the terminal pressure should not be, say, below .50 inch, as it might involve an increased initial pressure at the holder, with the accompanying disadvantages.

There remains the ascertaining the diameters of the pipes for the supply of gas to the districts, numbers (4), (8) and (12), in which there is an hourly consumption of 4,500 cubic feet, and a total length of 7,000 yards, with a pressure of .78 inch. What will be the diameter of the pipe from C to D′, having a length of 2,600 yards; and what will be the pressure at D′?

As the specific gravity of a given gas is a constant quantity in all these calculations relating thereto, and as .5 has been assumed to be that of the gas under discussion, instead of the two factors, .0000006 × .5, their product, .0000003, may be used for the constant quantity.

$$(9)\quad D^5 = \frac{.0000003 \times (4{,}500)^2 \times 7{,}000}{.78} = 54{,}519, \text{ requiring a 10-inch pipe.}$$

$$(9')\quad f = \frac{.0000003 \times (4{,}500)^2 \times 2{,}600}{100{,}000} = .16 \text{ inch.}$$

.78 — .16 = .62 inch, the pressure at D′.

$$(10)\quad D^5 = \frac{.0000003 \times (3{,}000)^2 \times 4{,}400}{.62} = 19{,}161, \text{ requiring a 8-inch pipe.}$$

$$(10')\quad f = \frac{.0000003 \times (3{,}000)^2 \times 2{,}300}{32{,}768} = .19 \text{ inch.}$$

.62 — .19 = .43 inch, the pressure at D″.

$$(11)\quad D^5 = \frac{.0000003 \times (1{,}000)^2 \times 2{,}100}{.43} = 1{,}465, \text{ requiring a 6-inch pipe.}$$

$$(11')\quad f = \frac{.0000003 \times (1{,}000)^2 \times 2{,}100}{7{,}776} = .08 \text{ inch.}$$

.43 — .08 = .35 inch, the pressure at D‴.

This last sized pipe may be reduced in like manner as was previously done, if there are not to be any extensions. Divide the 2,100 yards into two lengths of 1,700 yards and 400 yards, and let the corresponding quantities of gas discharged be 700 cubic feet and 300 cubic feet.

$$(11'')\quad D^5 = \frac{.0000003 \times (1{,}000)^2 \times 2{,}100}{.43} = 1{,}465, \text{ requiring a 6-inch pipe.}$$

$$f = \frac{.0000003 \times (1{,}000)^2 \times 1{,}700}{7{,}776} = .07 \text{ inch, pressure lost by friction.}$$

.43 — .07 = .36 inch, pressure at the end of the 1,700 yards.

$$(11''')\quad D^5 = \frac{.0000003 \times (300)^2 \times 400}{.36} = 30, \text{ requiring a 2-inch pipe.}$$

$$f = \frac{.0000003 \times (300)^2 \times 400}{32} = .34 \text{ inch.}$$

.36 — .34 = .02 inch, the pressure at D‴.

As a 2-inch pipe is too small, as a rule, for practical use, let it be 3 inches. What will then be the pressure at D‴? Since the fifth power of 2 is 32, and that of 3 is 243, and as the loss by friction is inversely as the fifth powers of the diameters, 243 : 32 :: .34″ : .05″, the loss by friction in the 3-inch pipe, 400 yards long. Therefore, .36 — .05 = .31 inch, the pressure at D‴, the quantity discharged being 300 cubic feet, the same as from the 2-inch pipe.

[To be Continued.]

[Official Report—Revised by the Secretary—Continued from page 728.]

PROCEEDINGS, THIRD ANNUAL MEETING, TEXAS GAS AND ELECTRIC LIGHT ASSOCIATION.

Held in the Menger Hotel, San Antonio, Texas, April 19, 20 and 21.

First Day—Afternoon Session.

Immediately after the close of the discussion on Mr. Lord's paper an adjournment to 3 P.M. was ordered. At the hour named the Association reconvened, and the President introduced the Mayor of San Antonio (Mr. Callaghan), who delivered the following

Address of Welcome.

Mayor Callaghan—Gentlemen: I am more than pleased to meet you. I have been requested by the citizens of San Antonio, who have received many kind returns at your hands, or those connected with you, to tell you that they feel proud that you have selected San Antonio as your place of meeting, and that they hope it will not be the last time. They also request me to tell you that we will have here shortly what is known as the "Battle of Flowers," and that you are all at home—for you are at home—and they want you to stay and "take it in," for we have taken you in. On behalf of the citizens of San Antonio I extend to you a hearty welcome, and sincerely hope it will not be the last time you will meet in this city. The gentlemen who illuminate the hours

when the sun has gone and the moon has disappeared, have rights that are dear to us, because at night, by electric light and gas light, San Antonio looks like a fairy. So I hope, gentlemen, that this will not be the last time that I shall have the pleasure of welcoming you to San Antonio. The city is yours—take it; and if you don't see what you wish, and if there is anything that you need, ask for it and it is yours. You are entirely welcome, gentlemen. (Applause.)

REMARKS BY MR. HOLMES.

The President—I have pleasure now in calling on the father, the grandfather and the grandmother of the Association (Mr. Holmes) to respond to the remarks of Mayor Callaghan.

Mr. Holmes—Mr. Mayor and Gentlemen: I tried to get out of this, but as it seems that I can't do so, I say to the Mayor and to the citizens of San Antonio that we are not only glad to meet with you, but that we are proud to do so. Doubt was expressed by some as to the advisability of coming here—it is a little out of the way, and not as centrally located as some of the other points; but I think now that all are very glad to be here. In fact, I have heard several gentlemen who now visit San Antonio for the first time say they are delighted and surprised to find such a beautiful city and to experience so lovely a climate. We have had, so far, a very pleasant time, and expect to have our pleasures increase as our stay is prolonged.

REMARKS BY MR. EATON.

The President—Gentlemen: I will take the liberty of calling on one from the North, who expresses himself as being perfectly delighted over the glorious climate of San Antonio and the Southern hospitality. We will listen to what Mr. Eaton, of Chicago, has to say for the benefit of Mayor Callaghan and the city.

Mr. Eaton—Mr. Mayor and Gentlemen: I hardly anticipated being called out before you, having been so recently elected a member of your Association; but I take great pleasure in telling you that it is not necessary for the citizens of San Antonio or Mayor Callaghan, or anybody else in this land, from my standpoint, to tell us that we are welcome. It is only necessary to place yourself in the position in which I was placed, coming here a few days ago, looking from the train windows, enjoying the warm sunshine and admiring the beautiful flowers and blue skies. In fact, the impression on my mind was such that I almost wished I might come here to live. It is very gratifying to have the courtesy expressed to us by the Mayor, and all that, and I am sure, although a new member of your Association, that this city was well selected when it was named for your place of meeting. Everything is in harmony. While we are here to listen to and digest some of those expressions so ably made by the gas and electrical engineers respecting their business, at the same time it is all the more pleasant to be enveloped by the sunshine and surrounded by the beautiful flowers and environed by the hearty hospitality of the city. There is no end to it; I have experienced it on every hand. I am grateful to you for doing me the courtesy of permitting me to speak to you of the impressions made upon my mind by San Antonio and its people.

The President introduced Mr. H. L. Monroe, of Dallas, who read the following paper on

INCANDESCENT LAMP EFFICIENCY: ITS IMPORTANCE TO CENTRAL STATIONS.

In the electrical business there probably is no other error so firmly rooted, so wide-spread, or so productive of bad results as the idea that the life of an incandescent lamp is its most desirable feature. Old-time conditions, when lamps sold at 75 cents apiece, are responsible for this idea; and it has been held, too, ever since, in spite of changed conditions and large reductions in price of lamps. The majority of lighting stations consider a lamp as they do a lamp chimney, as something which is good so long as it is not broken and can be made to burn. The considerations in purchasing incandescent lamps hinge in the majority of cases on but two things: The first, cost of the lamp; and second, the length of the time it will last.

Now, long life is not the most important feature of a lamp; it is not even a desirable feature, except when accompanied by efficiency. It no more determines the value of a lamp than does the width of a box tell its cubic contents. If an incandescent lamp maintains its *initial* candle power without loss, the lamp that burned the longest would without question be the best lamp. Such, however, is not the case. An incandescent lamp, far from maintaining its initial candle power, invariably loses its candle power from the time it begins to burn, barring a slight rise in candle power at starting. This feature of an incandescent lamp, it must be noted, is the characteristic of every incandescent lamp ever manufactured, and it must be considered entirely independent of blackening or discoloration of the lamp. Lamps will frequently lose in candle power over 50 per cent. and still show very little trace of blackening; and, conversely, lamps will frequently blacken heavily while losing very little in candle power.

It is the efficiency of an incandescent lamp, therefore, which is the primary and chief characteristic whereby its quality must be judged. By efficiency we mean two things. First, efficiency of the lamp as a light producer, as a transformer of light, its maintenance of candle power, its average brilliancy throughout its life; second, the efficiency as concerns the amount of power necessary to produce a given amount of light, or the economy of the lamp in watts per candle.

We will first consider the light-producing efficiency, as it is the most important feature of an incandescent lamp. A lamp is a real transformer, and the most important one of the whole lighting system, as it gives forth the very substance which the whole plant is constructed to produce; that is, light. If this transformer be poor or inefficient, it is clearly evident that the whole lighting system is vitiated and rendered poor or worthless. Now, an incandescent lamp is a transformer which loses in efficiency as it is used. It will burn efficiently for a certain period, and after that time its light amounts to only a fraction of what it gave during that period for the same power consumed. An examination of the characteristics of an incandescent lamp will give us a clear understanding of the facts and principles applying to its efficiency as a light giver.

The following curves (Diagram I.) will give us a pretty good idea of the situation.

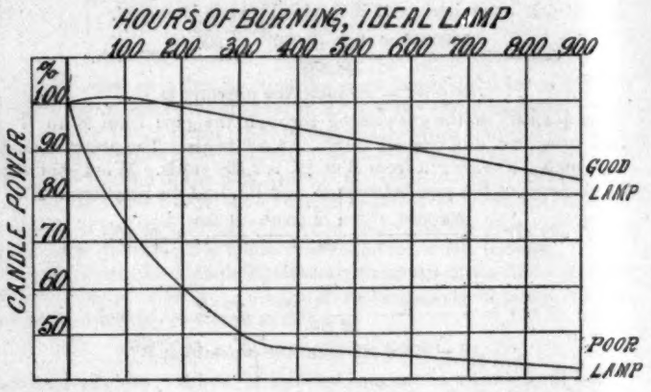


Diagram I.—Comparative Curves of Ideal Lamp. Good Lamp and Poor Lamp.

The horizontal scale gives hours of burning, and the vertical scale the percentage of normal candle power. By testing the candle power of the lamp at different periods, say every 100 hours of burning, we obtain points on the diagram which, when joined together by lines, give the curve before us. The perfect lamp is here shown with a straight horizontal line. In practice the deterioration of the filament increases its resistance, causing a loss in candle power, so that the line of candle power drops below a straight line, as shown in Diagram I. This drop in candle power is a most important characteristic of all lamps, and a feature that must always be borne in mind. The relative drop or loss of candle power, other things being equal, determines the quality of different lamps.

In the lower line in Diagram I., we have strikingly shown the poor lighting quality of a poorly made lamp, the candle power dropping to below 50 per cent. of the normal candle power inside of the first 300 hours of burning, and then holding on and burning at this diminished candle power practically indefinitely. Such a lamp, considered from the standpoint of light merely, would be an excellent lamp. Its resistance has increased to such a point that it is practically impossible to burn it out, and it will continue to burn at this diminished candle power, glowing like a red-hot hairpin, until the only remedy is to remove it from the circuit and break it with a club. With such lamps it would be easy to guarantee the individual light of each lamp, and yet it is very evident that such a lamp would be the very worst lamp possible for a station to use.

Referring to the curves of candle power, it is very important that the conditions of test be thoroughly and completely stated, and that comparisons be made on the same basis of initial economy, and with approximately the same voltage and candle power of lamps. On account of the relatively larger diameter of filament, low volt (50–55 volt) lamps are more stable than 100–110 volt lamps. A curve of candle power of

a 16-candle power, 50-volt lamp would follow, as shown in curve of Diagram II., which it is seen at once is well above the candle power curve of our high volt lamp. It would be manifestly unfair to compare low volt lamps of one make with high volt lamps of another make.

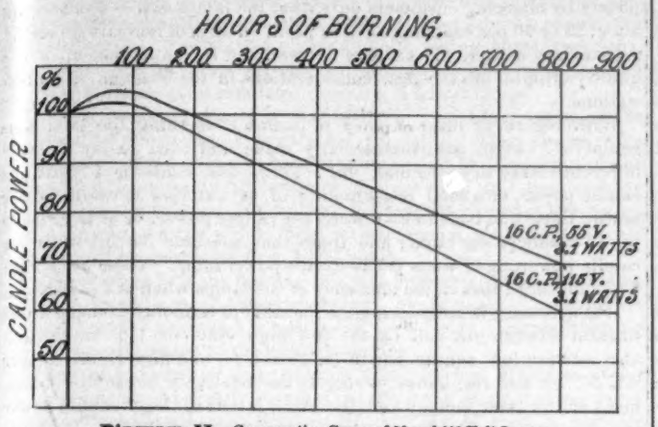


Diagram II.—Comparative Curve of 50 and 110-Volt Lamps.

The same cause, the larger size of filament, makes high candle power lamps more stable than low candle power. In Diagram III. we show how the candle power of a 32-candle power, 50-volt curve is noticeable. Practically the same difference is found between 8 and 16-candle power lamps. It is clear that it would be unfair to compare the results of an 8 or 10 candle power lamp of one make with that of 16 or 32-candle power of another make.

It is not enough, however, to simply have voltage and candle power to correspond; it is even of more importance that the lamps compared should be of the same economy. That is, the filaments should be burned at the same degree of incandescence. If we take a 20-candle power—3.1 watts per candle—114-volt lamp, and burn it at 110 volts, it will give 16-candle power, but it will not be burning at 3.1 watts per candle at this voltage. Its economy will be 3.6 watts per candle. If we now compare this lamp with a 16-candle power, 110 volts, 3.1 watts,

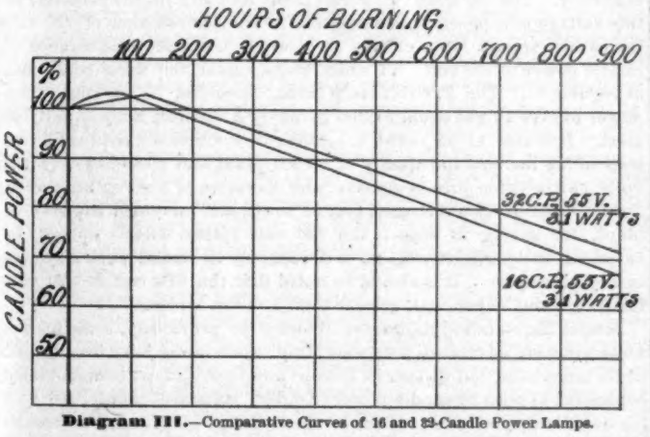


Diagram III.—Comparative Curves of 16 and 32-Candle Power Lamps.

lamp, we will have two filaments burning at different degrees of incandescence, although both are giving the same candle power; the 3.1 filament at a higher degree of incandescence is, therefore, subject to a greater strain than the 3.6 watts filament. The latter would have to be burned at 4 volts higher pressure at 20-candle power to strain it to the same degree. Equal comparison to these two lamps is manifestly unfair to the 3.1-watt filament. It is as unfair as it would be to take a 1½-inch rope and compare it with a 1-inch rope by subjecting them both to the same number of pounds strain. If we take the following curves (see Diagram IV.), it will be readily seen how we can apparently improve the quality of a lamp, by variation of the initial efficiency at which it is burned.

It is important to note that very small differences of initial efficiency are productive of considerable variation in results. A difference of $\frac{1}{10}$ of a watt in efficiency is a large amount in favor of the lower economy lamp. Not only are all these points to be observed, but the customer must also be on his guard against the incompetent or conscienceless lamp manufacturer who can easily impose deceptions of various kinds. Take the subject of candle power. How many customers know that the candle power of their lamps is as marked on their lamps? The only way of telling is by photometer tests by a skilled operator. The eye is no guide, for it is well known that 99 out of 100 people cannot

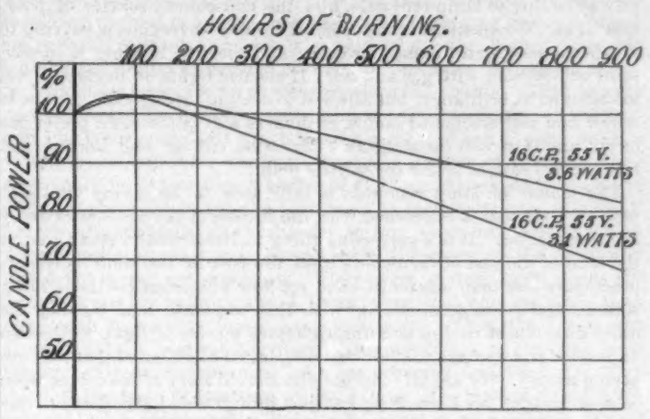


Diagram IV.—Comparative Curves of 3.1 and 3.6-Watt Lamp.

distinguish the difference between a 16-candle power and 20-candle power lamp. It is evident that by "fudging" on candle power a lamp can be made of apparently much better efficiency than it is in reality. Thus, a lamp taking 50 watts, if a full 16-candle power lamp, is of 3.1 watts economy; but if really only a 13-candle power lamp marked 16-candle power, its efficiency is much lower, or 3¾ watts per candle.

These points are mentioned for the purpose of noting that some more definite method of selecting and comparing lamps than simply the eye must be used, or how a batch of so-and-so's lamps burned at Mr. Jones' store. Incandescent lamps, when properly made, are highly organized articles, and proper discrimination should be used in their selection as well as in their use. It is extremely important to adopt a better method than that so frequently followed of buying the cheapest lamp that will last the longest, irrespective of any considerations of initial candle power, or of the power consumed in burning, or of what average candle power is given during life. The quality of incandescent lamps can only be determined by the average results obtained during life, and, therefore, only to be obtained after burning the lamps, or a certain number of them, under carefully regulated conditions. This makes the matter a difficult one for the average lighting station, and emphasizes the value of dealing only with reliable and well established manufacturers.

Returning to the subject of efficient candle power, the curves we have examined clearly show that there is a limiting period for all lamps to burn, beyond which, if they are continued in use, very dim and reduced candle power makes the light far more costly than if the dim lamps had been replaced with new lamps.

The electric lighting stations are in the commercial business of furnishing light, and, therefore, their aim and desire are to furnish the greatest amount of light at the least cost per unit. The unit of light being a candle power (the lamp measuring 16, 32, or any number of such units), that station will be operating in the most successful and economical manner which furnishes its candle power at the least cost. If we take the case of a new lamp burning, say, a life of 1,000 hours, and giving an average of, say, 12 candles during its life, the cost per candle power for this period will average about 20 cents say per candle. After this period, the lamp being still used, its candle power drops to an average of about 7, although practically taking the same amount of power that it formerly did, and the cost of candle power is increased to nearly double what it was before. Continuing this lamp in use beyond 1,000 hours results, therefore, in practically double the cost per unit of light.

Looked at in another light, economizing in lamps, by trying to obtain a long average light, it is a very short-sighted policy, and the worst of poor economy. Let us take the case of an average customer who pays for his lamps at the rate of $1 per month each. If he burns one of his lamps on an average of 4 hours per day, this lamp will have passed its useful life in from 6 to 8 months, and should then be renewed, so that the customer may receive his full quota of light. For the 6 to 8 months' use of this light the station has received $1 a month, or $6 to $8, and because the lamp still burns, dimmed and blackened though it may be, the station does not renew it and lets it burn on. What does this saving amount to? Simply this: That for the sake of saving 20 cents, which a new lamp now costs, the station jeopardizes $6 to $8 worth of

business. In the average case such a practice will lose a customer's business, and the saving of one lamp or a dozen can hardly be said to pay for such a loss. The history of poorly paying lighting stations of to-day will be found in almost every case to be the result of not properly attending to lamp renewals, and the consequent service of poor, dim light. Competition is the order of the day—everyone is striving to obtain the best for his money's worth; and electric lighting is in constant competition with gas and oil. If electric lights be neglected, not maintained at brilliancy, but allowed to decline through the failure to renew dim and blackened lamps, customers will in the main prefer gas or oil, and thus will the station's business be cut off and limited, and frequently brought below the paying point.

The matter of lamp renewals is thus seen to be a very vital subject, and one that is concerned with the success of the business of every lighting station. It is a surprising thing to know what a small part of the total of the cost of furnishing light the cost of the lamp represents practically less than one-tenth—and yet how numerous are the lighting stations that go on economizing with this one-tenth and wasting the other nine-tenths in dim and unsatisfactory service of light, to the loss of custom and damage to their business, in the blind belief that they are saving money. We are all familiar with the old story of the driver who, economizing on his horse feed, had just brought his horse down to one straw a day when the poor animal died. Its parallel is found in the electric lighting station which economizes on its lamps, never renewing them until they burn out, bringing the station down to a very limited number of lamp renewals, with the result of ruining the business and causing the company to pass into a receiver's hands.

From whatever point of view the subject of lamp renewals is reviewed, its importance clearly stands forth. A central station generally tries to obtain and use efficient boilers and engines, efficient dynamos, and to have a well-distributed service with small line loss, efficient transformers, and, in brief, a whole system of the very highest efficiency possible; yet when it comes to the end and aim of the whole system—the lamp—how little attention is given to the subject of its efficiency and the maintenance thereof.

It is important to note that, as far as the *customer's* end of the business is concerned, it would be better for a station to have everything inefficient rather than the lamp. The average customer does not know whether the engines and dynamos are efficient, or whether the line loss is small or large; but he does know and feels the result of inefficient lamps, and of lamps which are maintained in service a long while after their efficient life has been passed. Keeping good and bright lamps in place is just as much a lighting company's business as furnishing currents to give light. So important is this principle that the large illuminating companies in New York, Chicago and Boston, and other large cities, keep men constantly employed weeding out the dim and blackened lamps and replacing them with new ones.

This brings us to the subject of lamp renewals, and a few points here are worthy of note. There is but little question that the policy of free lamp renewals is the best for both stations and the customers. This is especially true at the present low price of lamps. It is only when lamps are renewed free that the station has full and complete control of its lighting service, which is necessary to perfect results. Such stations as furnish free renewals should not wait for customers to complain or return their dim lamps, but should see to it that their lighting service is maintained at the proper brilliancy, by steadily replacing all lamps that are dimmed and blackened. When lamp renewals are charged for, some inducements are necessary to make customers renew their lamps. The average customer will not think of doing this unless some inducement is offered him. One method which has been very productive of good results is to furnish new lamps, in exchange for dim ones, at a reduction in price on what is charged for renewing burned-out lamps. A customer, for example, who returns his dim lamps can purchase the new ones at, say, half price; and he would, therefore, save by returning his lamps in preference to waiting and paying full price when they burned out.

Another method adopted by a number of stations is to offer lamps for renewal at something below cost, say 15 cents each, the Company reserving the right to say when the lamps should be renewed. Should a customer complain when the company renews his lamps he would be easily persuaded that he was not unjustly treated, in view of the fact that the station was furnishing his lamps at less than cost, and, therefore, acting in purely a disinterested way for his own good.

It is poor economy for a station to try to make money on the sale of lamps. A lighting station is in the business of selling light, not lamps, and the attempt to force customers to pay more for lamps than the cost always results in making customers hold on to their lamps beyond their proper life, to the deterioration of good lighting and the damage of the station's interests. Most stations believe that charging high prices for lamps compels contract consumers to use light sparingly, but it has been shown by experience that such results are obtained just as completely by charging customers only what the lamps cost as by charging about 25 or 50 per cent. more. The profit on sales of lamps is decidedly a secondary matter. The sale of current, and the improvement in the quality of light, are the first considerations in the business of central stations.

With regard to the efficiency of lamps concerning the total consumption: Lamps are commercially made and used to-day in three different classes of economies, viz.: Those that consume 4 watts per candle power, or a total consumption of 64 watts per 16-candle power lamp; those that consume 3.6 watts per candle power, or 57 to 60 watts per 16-candle power lamp; and those that consume 3 to 3.1 watts per candle power, or 50 watts per 16-candle power lamp. These are all initial efficiency; that is, the efficiency of the lamps when put in use.

It is necessary in considering the question of economy to make a distinction between low volt (50-55) and high volt (100-110) lamps, and also between low candle power (8, 10 and 16) and high candle power (32, 50, 100 and 150) lamps, owing to the relatively larger size of filament of low volt lamps; and the same is true of high candle power lamps as compared to the usual candle powers of 10 and 16. With regard to the low volt lamps, the greater stability of their filament has always been a point in their favor, but the difficulties of good pressure regulation on 50 volt secondaries, with the necessary use of a number of small transformers, supplying a number of installations each, greatly improves the regulation as compared to the old method of using a transformer for each installation.

The change from low volt to high volt lamps has been steadily going on for the past two or three years, so that the low volt lamps manufactured and used to-day form a much smaller proportion of the total number of all kinds of lamps. It will be safe to predict that low volt lamps will sooner or later be practically obsolete. The tendency is all the other way, going to higher voltages, 220 volt lamps are now successfully made and used. They have been made in small lots for several years, but in the past year their introduction and use called for a large number of these lamps.

The use of 220 volt lamps is rather a backward step, as regards efficiency. The 220 lamp is a 4-watt lamp, and any higher economy in this voltage is at present uncommercial. The performance of 220 volt lamps corresponds very closely in average life and maintenance of candle power to 110 volts, 3.1 watts lamps, under the same conditions of regulation. The 220 volt lamp takes, therefore, 30 per cent. more power to give a light equal to that given by a 110 volt lamp equally as good. It is also to be noted that their low efficiency requires a corresponding increase in capacity of steam plant and dynamos over 110 volts; two or three wire systems for the operation of a given number of lights. Against this increased cost of power and increased capacity of plant, the saving in copper the 220 volt system effects should be balanced, to determine whether it is economy to install such a system in any given case. It is also to be noted that the first cost of 220 volt lamps is about 25 per cent. greater than 110 volt lamps.

Besides the standard economies referred to previously, some manufacturers have advertised a 2½-watt lamp. Such lamps have been talked of for some time, but neither in Europe nor America has a commercially successful 2½-watt 16-candle power (English standard candle) 100 volt (or over) lamp yet been produced. Such lamps give a short average life (less than 300 hours) under the best conditions of regulation, and their candle power is maintained but poorly. You will note that I have limited this statement to lamps of 100 volts and over. In 50-volt range it is possible to produce a 2½-watt lamp giving results approximating that of 16-candle power, 110-volt, 3.1-watt lamps, under the same conditions.

Such lamps it is not practical to use, however, as the regulation of 50-volt circuits is generally too bad, even for 3.1-watt lamps, so that 2½ watt lamps are for the present confined to the laboratory, or to such limited applications as the lighting of railway coaches from storage battery current.

Returning to the standard lamps: Lamps of 3.1-watt efficiency are to be used where the pressure is regulated very closely, or, in other words, where the voltage is at all times practically perfect. Such a regulation, of course, can only be secured by constant, careful attention to every detail.

Lamps of an efficiency of 3.6 watts per candle should be used where the regulation is only fair, or where the voltage may vary some, but at no time averages more than say 4 per cent. high.

It is possible to produce columns of figures and curves by which to determine the proper efficiency of lamps to be used with different stations. Such a question, of course, should be decided upon the average efficiency of lamps during their life. For a plant properly run, however, we know of no better method than selecting the highest efficiency consistent with its regulation, which will, in general, correspond to the following: For isolated plants and alternating current sections, 3.6-watt lamps; for direct current, central stations, and large isolated plants with thoroughly regulated pressure, 3.1-watt lamps.

An accurate record should be kept of the average life of lamps on the entire station where free renewals are furnished. Then the average candle power of lamps can be kept at proper point by taking out of the sockets and breaking up all lamps which are dim, and thus steadily maintaining the average life, so that it does not exceed 1,000 hours. There is no lamp made which, from an economical standpoint, should be continued longer in use than 1,000 hours.

In the average case the limiting life will be nearer 600 to 800 hours. A station should aim at these points, and by persistent, constant renewals, keep the average life well below 1,000 hours, thus maintaining the average brilliancy of the lighting service.

Whatever economy or make of lamp a station may decide to use, it by no means can so greatly increase the efficiency as by making every possible effort toward maintaining a constant use of reliable portable voltmeters. A station should not rely on its station's instrument, but should, by means of the portable voltmeters, take frequent readings all over its circuits, correcting and reproportioning its lines so as to give a uniform voltage at all points. It is a common mistake to think that the lamps are at fault in cases of extreme breakage. When high pressure abounds it is always the new lamps that burn out. The old ones hold on and continue to burn. The natural tendency of the station manager is to blame the new lamps, and to conclude that the pressure cannot be high, since the old lamps do not break, and only the new ones are affected. This is a common mistake. The old lamps have been subjected to the gradual increase of pressure which generally increases from month to month, a volt or so at a time. In this way an old lamp can be made to stand a pressure 4 or 5 volts high. But install a new lamp on this circuit, and it is subjected to this increased pressure all at once and generally breaks. It is well known that a strain suddenly applied has double the force of a gradual application. A stick that would only bend under a gradually applied force will be broken into pieces by the sudden application of the same force. So then, the burning out of the *new* lamps *only*, far from being an indication that the pressure is not high, is very good evidence that it is high, and that a test of the circuits should be made at once and the pressure regulated. Quite a number of the central stations have adopted the method of increasing their voltage in order to give an increased brilliancy to their lamps. Such a practice is reprehensible in every degree, and can only result in bad service. The old lamps will, of course, have their candle power increased by such increased pressure, but the new lamps will either burn out very rapidly or lose in candle power by the effct of the increased pressure, so as to decrease their natural useful life in a very large degree.

If a 16 candle power lamp is operated at a pressure of 3 to 4 volts high, it is made to give 20-candle power, and the curve of candle power will resemble very much the path of flight of a skyrocket, going up and then coming down again very rapidly. The result is, of course, to shorten the period of useful light very much. The lamp burns very brightly for a short period, and then rapidly falls to a dull degree of incandescence. Owing to the extreme contrast between the increased brilliancy at first and the reduced candle power soon after, a customer is apt to feel much more dissatisfied with it than with the lamp burned at its normal voltage, and neither giving increased brilliancy nor suffering such a rapid diminution of light. If a station needs more light as a result of competition with Welsbach burners, the best way is to purchase 20 to 24 candle power lamps, whose first cost is no more than 16's, and maintain the normal voltage of the lamps. So necessary is this matter of regulation, and so disastrous are the effects of high pressure upon not only the life but the candle power and light-giving qualities of a lamp, that we beg to repeat that nothing is more important as affecting the efficiency of a station than the maintenance of constant voltage of the lamps.

Discussion.

The President—Mr. Monroe's paper is now open for discussion.

Mr. Lord—This is a very exhaustive paper, and it is also one that affects every light and power station in Texas. A most important question is the selection of the lamp best fitted for the particular station.

Mr. Cox—The paper is not only exhaustive, but it is also very well written. One point in it that I think should be discussed a little, from the standpoint as to whether it is better for the station or the customer to supply the lamps. Of course, taken on the question as to whether you are supplying light or whether you are supplying current, the case presents two very different features. For my part, I contend that I am supplying current to a lamp, as a gas man is supplying gas. While I am perfectly willing to admit it is best to use the higher economic lamp, if the station is operated entirely on the meter, the station really isn't the loser by any kind of a lamp put on the circuit. That is very poor argument, because the customer is not the beneficiary of the current; he is the poor devil who is paying for it. When I went to Galveston the custom there was to renew the lamps free of charge. They were charging at that time a matter of $1.75 per 100 ampere hours, or 1¾ cents. I managed to get the Company to reduce its rate to a cent, but we also requested our customers to buy their own lamps, which determination made a very considerable difference in the profit and loss account for the company. They were giving away about 800 or 900 lamps per month; and I think since that time not more than one-fourth that many lamps have been sold. Then the lamps cost about 18 cents; now a little more. The regulation of the lamp is of the most extreme importance, both for economy and for light. One point on the basis of practical utility I think Mr. Monroe might have covered in his paper—probably he did, however, as I wasn't present when he commenced to read—regarding the efficiency of the lamp. I think a majority of the central stations are absolutely forced to depend entirely upon the make up of the lamp for economy. Very few stations have apparatus with which to test it. Mr. Monroe made a very pointed remark, that every station should operate with a portable watt meter. They are on the market now, and any man by their aid will be able to tell the power of his lamp. You are all acquainted with the formula of the T-H watt meter. Take the copper disk and put a chalk mark on it, put the meter in the center with one lamp first, adjust the voltage of the line to agree with the voltage of the lamp, and notice the revolutions that that disk will make in one minute of time. The revolutions multiplied by 60 and by the constants on that meter will give you the watts consumed. For instance, say we find it makes two revolutions in one minute. Twice 60 would be 120, and constant half reduces it to 60 watts consumed. Those who have the Shallenberger meter, also have a set of constants. Instead of going by the minute you can go by the 120 seconds. On application to the factory they will give you a table of constants to these meters. I use a meter myself, and once in a while I go around town and ask the supply men to give me a sample of their lamps, which I test. If I find any of them using anything more than a 3.6 lamp, we say most emphatically that we are in the lamp business ourselves. If we should meet with any trouble in that line I think we should adopt the method of getting a large number of lamps, say 10,000 from some reliable factory, on whose guarantee we could depend and then compel the supply men to buy them from us. I think, though, where the stations are larger, such as those in New York, Chicago, Boston and San Francisco, usually known as the Edison companies, whose business is sufficiently large to warrant keeping out special men, that it would be a far better way for the central stations to provide the lamps. Where the station is small you will find it will take a great deal more expense to furnish the lamp; it will be of importance to find out whether or not it is economy to do so. There is no question about it when it comes to the large stations.

Mr. Cushman—In some instances the converters are loaded, while in others they are not loaded and the regulation can't be perfect. In such instance it would be more than 3 or 4 per cent.

Mr. Monroe—That brings it to the point which I tried to make clear in the paper—using large converters. With small converters it is impossible to get better than 4 per cent. regulation. You can on light loads. In cases of that kind it is going to be at the expense of the lamp.

Mr. Cushman—If you have a large station and are operating several circuits from one machine, some full and some light, all computed for the same loss, the line loss goes up on some and down on others. The regulation can't be the same from the machine. What sort of a feed regulator do you have?

Mr. Monroe—There has been in the past year a new regulator developed, to take care of the trouble you mention. I cannot give you the efficiency, however.

Mr. Cushman—Is it regulated by hand, or on the line?

Mr. Monroe—It is regulated automatically on the line.

Mr. Lord—We have the Stilwell regulators on our circuits, of which we have six circuits in the city, each one independent of the other regulator. Probably we have six to ten amperes on each circuit. We can throw all circuits on to one machine and a regulator on each cir-

cuit, and we can put down the pressure to suit. We have found the 3.6 lamp the best suited to 50 volt. Our regulation is very good. I made a test of two lots of 50 lamps—I will not mention any name. I burned each lamp, keeping on a slip the date the lamps started to burn and when they burned out. In one 50 lot we got an average of 690 hours; the average life of the other lot was 750 hours. That is what I call the happy medium lamp, the best suited for us. We give away lamps to our customers. When a party uses the lights on a meter we sell him the first equipment at 30 cents; if in large quantities, at 25 cents. If those burn out in a reasonable length of time and he brings back the old lamp, we give him a new one free of charge. I take into consideration the consumer's wants to some extent; I think it pays in the end. Take a lamp that will consume more current, and they will kick about it. We can afford to give them a 600-hour lamp free. Our contract consumers buy their own lamps. We have minimum bills and meters. We find the 3.6 is the best lamp for us.

The President—How do you prevent the contract consumer from changing with the meter consumer—taking his lamps over to the meter consumer and exchanging?

Mr. Lord—We haven't any of that class of customers. The greatest trouble we have is in making a contract with a consumer for 16-candle power lamps. A supply firm in our city sells lamps. The man never comes to us for a lamp, but he buys a 32-candle power lamp and we furnish him the power for a 32. If we could control the sale of lamps it would pay us to sell them at cost.

A Member—Wouldn't it pay to give them away?

Mr. Lord—I believe the customer should pay a reasonable amount.

Upon motion of Mr. Fitzgerald the Association extended a vote of thanks to Mr. Monroe for his paper.

The President introduced Mr. W. E. Holmes, of Austin, who read the following paper, entitled

LITTLE THINGS.

In our business we are sometimes careless about the little details, the little expenses, the little leaks here and wastes there, the careless habits of our employees that lead to useless or unprofitable labor, or to the waste of fuel, material or power, in many ways. We see them, these "little things" every day, and we think that they are too small to consider—that they don't amount to anything. In many cases, perhaps in most, the neglect of the little details is the invisible leak through which hundreds, and perhaps thousands, of dollars waste away each year.

There are many things to be looked after, two or more sides to every question, and each plan, method or system has its advantages and its disadvantages, and must be carefully weighed and considered both as a unit, complete in itself, and as a part of the whole. No fixed rule will apply in all cases and under all conditions, but each must decide for himself; and always the final and decisive question should be, "Will it pay?" The answer to this question should never be "guessed" at, but should be carefully figured out, that we may know exactly what to do, what not to do and why.

By such a process we frequently find that some of our nice little pet theories or notions vanish and are no more; but we save money, expressed in actual dollars, and in time and energy that might have been wasted in fruitless effort.

We can get a good many ideas—ideas that will help in many ways, by reading and noting the articles, papers, discussion, comments and experiments—even the advertisements, in not only our own journals and periodicals, by which I mean those devoted exclusively to our business, but also those devoted to our competitors (for we all have competitors) and to related or similar industries.

The *Western Electrician*, of April 10th, has a paper by Mr. B. J. Arnold, devoted to the "Cost of the Production of Power," one of a series of articles on "Design and Construction of Electric Power Plants" that is very good indeed. It is clear, direct and practical; and if we study that paper carefully, any one of us should be able to save from $100 to $1,000 within the year.

The most formidable competitor is the man who knows not only his own business thoroughly, but knows also just about what we can and cannot do in our business.

Out of the mass of matter relative to "Smoke Abatement" and experiments with numerous systems, methods and types of so-called "smoke consuming" furnaces and devices, many useful hints can be gleaned as to manner and method of regulating drafts, air supply, type of furnace for the various classes of coals, and best methods of using each under varying conditions. In regulating the air supply to our furnaces it is sometimes hard to determine just when we have enough, and not too much, air: for one type of furnace or class of fuel requires an abundant air supply at one point and but a limited quantity at another, while with another class the requirements are entirely different. An easy, practical test is to introduce a jet of gas into the flue leading to the stack and noting through a glass arranged in a sight-plug the action of the flame. If an abundance of free oxygen is present the flame burns readily, while if there is little or no free oxygen the flame is correspondingly feeble, or does not burn at all. By a little experience and observation this method can be used with good results.

In the retort and purifying house a multiple gauge by which, by simply turning a key, we can ascertain the pressure at any point, is a source of great satisfaction and a money saver. In case of "stoppage" it not only saves time, but enables us at night to ascertain the pressure in rooms and at points where we could not use a light. A tar take off that takes off tar without undue and constant persuasion, and a seal or dip regulator that can be properly adjusted and relied on, are little things that make or lose money. Regular, systematic and thorough daily, weekly and monthly inspections, tests, reports or notes, and comparisons are mighty factors in getting and maintaining good results, and should have more attention than most of us give. They need not, and should not, be elaborate; but simple and practical.

The methods of firing, the manner of stirring the fires, of "clinkering" the furnaces, even the shape and manner of handling the shovels, scoops, bars and other tools are matters that should be noted and improved on if necessary.

Some have no record of the gas or current made and sent out—that is, no reliable record. They simply "guess" at it, and consequently do not know what the leakage, or loss, or "gas unaccounted-for," or "current unaccounted-for," amounts to each day, week or month; and some of us who do keep such a record think if some of those who do not keep it would make a careful and accurate record of the output for, say, one month, and check that against the sales for that month, they would find the item "unaccounted-for" to be "something terrific," and would find that 10, 20, or, shall we say, even 40 per cent. of the fuel used is to make this sendout for which they get no return. When investigated a part of this item "unaccounted-for" will be found to be a natural and unavoidable leakage or loss; but a large percentage is simply waste, perhaps and probably in several different ways, but waste that may be and should be stopped. Prominent among other sources of loss it will be found that the flat rate consumer is getting from 25 per cent. to 300 per cent. more light than he is paying for. Just here I would like to ask the advocates of the flat rate system how it is that they cannot profitably supply light by meter for less than, say, 1 cent an hour; but will supply the same light on a flat rate basis for perhaps ½ or ¼ cent per hour?

To describe in detail, and to decide as to the many things to do and to leave undone, in one department even on one machine, working, as they must, under varying conditions, is clearly impossible in a short paper; but we may take up one or two items only, and see what may be done by close attention to some of the little details we sometimes neglect. Take the item of coal. Although "mine weights govern settlements" (and freight bills), we, if practicable, have it weighed from the cars into our bins, and from the bins every pound that goes into the retorts, into the retort furnaces, into the boiler furnaces, or is used for any purpose, is carefully weighed and a permanent record made, not only of the coal used in each department, but of the number of pounds used in each separate unit. This enables us quickly to detect and correct any unusual trouble or abnormal waste, as well as to know that we are getting proper results from each. But, having done this, have we done all that we could or should do? I do not think so.

When we are running full capacity all around we find it economical to use the best grade of fuel, but when the load is light we continue to use the same fuel, while if we know how to handle it, and will think a little, we may find that, with a light load, a lower and cheaper grade of fuel—a nut, pea, slack or lignite coal—will give equally good results, and will effect a saving that, while not large for any one day, will make quite a nice little total at the end of the year.

Now, the furnace. Notice that leak where the air is drawn in around that sight plug, or around the door frame, or through that crack or seam in the brickwork. What does it do? It is above or beyond the effective combustion line, so the air enters and mingles with the furnace gases, absorbing the heat that should be given off in useful work. "Very small matter; doesn't amount to anything, practically," some say. But suppose we consider it carefully. Easy, approximate values only, well within practical values, are used; for, to carry out with laboratory exactness theoretical and practical values will be unnecessarily burdensome.

Suppose 3 pounds of air at a temperature of 60° enters the furnace

through these leaks each minute. It does no work, but absorbs heat; and finally goes to the stack at 460°. Say it takes 300 heat units to raise the 3 pounds of air 400°. Say it takes one-tenth of a pound of coal to generate 1,000 heat units. If we are running three furnaces we are wasting only about 43.2 pounds of coal per day, but at $4.20 per ton this makes about $100 per year.

If we stop those leaks and save that $100, as well as a like sum by not using high grade and expensive fuel when a cheaper quality would do as well, and another $100, by attention to the manner of firing, stirring fires, adjustment of dampers and air supply, etc., we have $300 saved on fuel alone per year. Now, if we have been earning 5 per cent. on $60,000 for our stockholders, we can, with this $300, pay a 5½ per cent. dividend. Then possibly some of our stockholders live where money is worth only about 5 per cent., and when they get checks for dividend on a 5½ per cent. basis, one of them may write somewhat as follows: "While I was getting 5 per cent. dividends on my stock I could sell it for only about 100, but if you will keep up this 5½ dividend I can get 110 for it." If that gentleman has 100 shares he is $1,000 better off, and naturally is in a good humor. On the same basis you have increased the value of the plant $6,000. Then that director, the one who bothers most and helps least, will look wise and important and talk of how well "we" (the directors) have managed affairs, and the first time he sees us after getting his dividend check, he will probably "set 'em up" to a "good cigar" (for 5 cents).

First, and indispensable to the greatest success, is a thorough knowledge of the fundamental principles underlying the construction and operation of each and every part of our plant. Not only how each does its work, but why it does it. Then, if we study each furnace, setting, boiler, engine, dynamo, generator—every machine we have, not in a far-off, abstract way, but closely, intimately, thoroughly, until we are familiar with the little peculiarities, the capacities and limitations of each, and how to get the best results from each under the many varying conditions found in practice, we will be capable of making and saving money in many ways.

No mention has been made of the office or of the street work. Each is a small world in itself, and of equal or even greater importance than the field we have been considering, and should an entire paper be devoted to each, it could but outline, as this has done, some of the little details that should have our attention.

(To be Continued.)

[Translated for the JOURNAL, by Mr. Herman Poole.]

The Utilization of Fuels.—No. II.

By "R.," in *Le Genie Civil.*

Preparation of Water Gas.—When the vapor of water passes over wood charcoal or coke, maintained at a temperature of about 1,000° C. (1,832° F.), it is decomposed by attacking the carbon and produces a mixture of hydrogen and carbonic oxide in equal equivalents, and also in equal volumes.

Supposing that we use 9 pounds of water, containing 1 pound of hydrogen, we consume by the reduction 6 pounds of carbon and obtain 1 pound hydrogen, occupying a volume of 179 cubic feet, and having a calorific power of 34,462 heat units, 14 pounds of carbonic oxide, having a volume of 179 cubic feet and a calorific power of 78,498 heat units.

But the operation requires the consumption of heat equal to the difference between 34,462 heat units, absorbed by the decomposition of the water, and heat units produced by the partial oxidation of 6 pounds of carbon, or a difference of 19,631 heat units.

We might furnish this heat by external heating of the retort, as is done in the laboratory, but the loss of heat would be enormous in this case and the working would not be economical.

We obtain, on the contrary, excellent results by producing the necessary heat from the simultaneous combustion of an excess of carbon; that is to say, by sending into the furnace a mixture of aqueous vapor and air, the latter being to burn the carbon. As the object is to have the gas the most combustible possible, the air should be admitted in quantity just sufficient to produce only a very small amount of carbonic acid. But, moreover, it is necessary that the temperature should be kept at about 1,000° C. (1,832° F.) at all times, so that the reduction may operate well. On this foundation and supposing that we produce only carbonic oxide, without loss of exterior heat, we will calculate the conditions of the process, using 9 pounds of water.

The weight of carbon consumed is 6 pounds, for the reduction of the water, and p pounds for maintaining the temperature at 1,000°. The last consumes $p\frac{8}{6}$ pounds of oxygen to become carbonic oxide, and this oxygen is accompanied by $p \times 3.33$ pounds of nitrogen. The products of combustion are then:

1 pound hydrogen from decomposition of the water;
14 pounds carbonic oxide from the decomposition;

$p\left(S + \frac{8}{6}\right)$ pounds carbonic oxide from the combustion;

$p \times 3.33$ pounds nitrogen from the air used.

The quantity of heat absorbed by the reduction is 19,631 heat units, and the combustion produces $p \times 1,122$; besides, the gases mentioned leave the machine at a temperature of about 1,000° C. (1,832° F.), so that the equation becomes:

$$p \times 2,473 = 19,631 + \left[1 \times 3.41 + \left(14 + \frac{14}{6}p\right) \times 0.245 + 3.33\,p \times 0.244\right] 1,000;$$

from which we obtain— $p = 24.63$ pounds.

So that the quantity of carbon burnt is at least four times that which serves for the decomposition.

The heat carried away by the gases is 41,285 units, or about 14.6 per cent. We may regain a part of this either by using them warm or using them to evaporate and superheat the water and the air used before passing them into the furnace. Supposing the recovery perfect by the latter method, the quantity p becomes—

$$p = \frac{19,631}{2,473} = 7.94 \text{ pounds.}$$

In the first case the gas would contain—

	Calorific Power.
1 pound of hydrogen	34,462
$14 + \frac{14}{6} \times 24.63 = 72.964$ (*sic*) pounds carbonic oxide	175,332
82,018 pounds nitrogen	0
	209,794

The proportion of hydrogen is 0.64 per cent., and the calorific power 1,345 heat units. In the second case the gas would have—

	Calorific Power.
1 pound of hydrogen	34,462
$14 + \frac{14}{6} \times 7.94 = 32.526$ pounds carbonic oxide	78,160
$\frac{26,440}{59,966}$ pounds nitrogen	0
	112,622

The proportion of hydrogen is 1.67 per cent., and the calorific power 1,877 heat units.

By way of comparison let us remark that the poor gas obtained from burning carbon in dry air makes only 829. We see here plainly the interest that is shown in practice in adding the aqueous vapor to the air in the gasogene, but we do not arrive at a perfect recovery because of loss of heat, since the consumption of carbon is generally more than three times that needed to reduce the aqueous vapor; the proportion of hydrogen (except that which is provided by the combustible itself) reaches hardly 1 per cent., and besides the gas always contains a little carbonic acid. So that the weight of the vapors decomposed is about $\frac{1}{15}$ of that of the air admitted, and the calorific power hardly reaches 1,400 units. Such are the facts to be considered in the construction of a plant for making producer gas.

With a perfect recovery, there would be no quantity of heat lost in the transformation, and in fact the quantity which we have found 112,622 heat units is equal to the product 8,080 × 1,394 = 112,635, except a slight difference due to neglected fractions. But of this we have a loss of at least 20,000 units, or 15 per cent. due to carbon consumed.

Well made water gas, containing 1 per cent. of hydrogen, 43.28 per cent. of carbonic oxide and 55.72 per cent. of nitrogen has a density of 0.96 and a calorific power of 1,384 units. The consumption of one pound of carbon produces 5,394 pounds, or 68.83 cubic feet of gas. A pound of the producer gas requires for its combustion, 0.3272 pounds oxygen, or 1.42 pounds air, and the theoretical temperature would be 2,325°.

$$T = \frac{1,384}{0.09 \times 0.48 + 0.68 \times 0.22 + 1.65 \times 0.244} = 2,325° \text{ C. } (4,217° \text{ F.})$$

By reason of dissociation, as in the preceding cases examined, we may obtain actually elevated temperatures up to 1,700° C. (3,092° F.). Even with poorer gases of 1,100 to 1,200 units as are made usually in prac-

tice, we obtain nearly this maximum, since these gases always contain a small amount of hydrogen obtained from the distillation of the combustible. The flame of the producer gas is longer than that of hydrogen for the same volume of gas burnt, because the complete combustion requires a relatively larger supply of air.

Combustion of the Vapor of Carbon.—We have seen that the combustion of solid carbon produces a quantity of heat the greater as the carbon is less dense, least in the crystalline state; that is to say, much greater as the molecule is least condensed. The difference corresponds to the molecular work accomplished during the interior change. It is still more marked in passing to the liquid or gaseous state, and to determine it we must have measured the latent heats of fusion and vola tilization of carbon.

We do not possess those data, but we can calculate the calorific power of carbon vapor by admitting as approximately true the law of Welter, which is the equality of quantities of heat developed by the accession of two successive equal quantities of oxygen to a given quantity of combustible without change of state.

Now, one pound of carbon, in the condition of carbonic oxide, develops 5,607 units by the introduction of 6 pounds of oxygen, which changes it to carbonic acid. If the law of Welter is true, one pound of carbon would produce 5,607 units by the action of 6 pounds of oxygen necessary to change it to carbonic oxide, it follows that the calorific power of carbon vapor would be 11,214 heat units. We must, never theless, correct these figures a little to account for mechanical work. Carbonic oxide occupies 29.8 cubic feet, and the oxygen 14.9 cubic feet. This latter amount disappears totally since the volume does not change.

The work thus produced and consumption of the heat equals $\frac{9,607}{425} = 23$ units, so that the calorific power of gaseous carbon in carbonic oxide is $5,607 - 23 = 5,584$ heat units; and this number must be used for the formation of carbonic oxide by carbon vapor, because there is no condensation in this case. We may then admit without much danger of being far from truth the number $5,584 + 5,607 = 11,191$ heat units for the calorific power of carbon vapor.

The difference between this and that given for solid carbon is great; it's quite probable that it is not less for hydrogen, and that this substance in the solid state would give only two-thirds of 34,462, or about 24,000 units.

The difference must be applied principally to the change from the solid to the gaseous state, for the latent heats of fusion are relatively quite low—from ⅛ to ¼ of the latent heats of volatilization. We may then without fear of large errors admit for the three states—

	Hydrogen.	Carbon.
Solid state	21,000	8,080
Liquid state	26,000	9,000
Gaseous state	34,462	11,191

If uncertain how correct these estimates are, they still possess a cer tain interest in the study of the combustion of complex bodies.

Combustion of Hydrocarbon Gases.—The most simple bodies to study after hydrogen and carbon are the gases formed by the combination of these two elements.

The first (marsh gas) forms almost the whole of coal mine gas and a large portion of illuminating gas. We will consider it as being 1 volume of carbon vapor united to 2 volumes of hydrogen and condensed to 1 volume.

Heated to a red heat this gas decomposes into solid carbon and hydrogen; but when burnt in a current of oxygen or of air the flame is not luminous, which must be attributed to the fact that the decomposition taking place only at a high temperature, both the two bodies burn at the instant that they separate without there being an instant of solid particles in suspension in the flame and becoming incandescent.

Hydrogen forming a quarter of the total weight, the sum of the calorific powers for 1 pound of gas will be:

For .75 pound carbon	.75 × 8,080 =	6,060
For .25 pound hydrogen	.25 × 34,462 =	8,615
Total		14,675
Actual power measured		13,063
Difference		1,612

This comprises the heat of compression 136 units, and besides, 1,488 units representing the heat of combination between solid carbon and hydrogen compressed at 2 atmospheres.

Still it appears more rational to consider the carbon as gaseous in the combination. The calorific power will then be:

For .75 pound gaseous carbon	.75 × 11,191 =	8,393
For .25 pound hydrogen	.25 × 34,462 =	8,615
Total for the mixture		17,008
While actual experiment gives		13,063
Difference		3,945

the heat of combination of gaseous carbon and hydrogen taken under ordinary pressure without deduction of 272 units, due to the two volumes disappeared.

The density of marsh gas being 0.556, 1 pound of the gas occupies 22.4 cubic feet. Its combustion requires 4 pounds of oxygen or 17.32 pounds of air, occupying a volume of 214.42 cubic feet, and containing 13.32 pounds nitrogen; it produces a mixture of 2.25 pounds aqueous vapor, measuring 45 cubic feet, 2.75 pounds carbonic acid, having a volume of 22.6 cubic feet, with 13.32 pounds nitrogen, of a volume of 170 cubic feet. In all the volume is 237.6 cubic feet. The theoretical temperature of the combustion is:

$$\frac{13,063}{2.25 \times 0.48 + 2.75 + 13.32 \times 0.244} = 2,647° \text{ C. } (4,769° \text{ F.})$$

By reason of dissociation playing its role we actually reach only 1,700° C. (3,092° F.) as with the simple gases.

The volume of the gases being at 0°, 237.6 cubic feet, at the temp rature of 1,700° C. (3,092° F.), they will become 1,478 cubic feet. If the diameter of the gas tube is 0.1, that of the annular air opening will would be 0.36, and that of the largest passage 0.88, which means that the air ports shall be larger, the central port twice as large as in the case with pure hydrogen. Marsh gas is better adapted, then, than hydrogen for heating large furnaces.

This difference is more marked on account of the state of condensation of the hydrogen in the compound. The length of the flame commencing at 700° C. (1,292° F.) and finishing at 1,000° C. (1,832° F.) would also be greater than with hydrogen, and still greater than with carbon, on account of the high specific heat of aqueous vapor.

The examination of olefiant gas leads to some remarks parallel to the preceding.

Formed probably of two volumes of carbon vapor united to two volumes of hydrogen to make one volume only of gas, it decomposes easily by dropping one-half of the carbon which remains in suspension in the flame and gives a peculiar appearance. Unless in a mixture with warm air and under pressure, the carbon is in excess, and this gas burns difficultly and produces smoke.

By weight hydrogen forms one-seventh of the gas. The sum of the calorific powers would be then:

For $\frac{6}{7}$ carbon	$\frac{6}{7} \times$ 8,080 =	6,925
For $\frac{1}{7}$ hydrogen	$\frac{1}{7} \times$ 34,462 =	4,928
		11,853

The measure power is 11,853 heat units. These numbers are then equal. There is a loss in volume with an amount of work of 20 units, and it is evident that the combination of solid carbon and gaseous hydrogen corresponds to a very slight absorption of heat; proving, moreover, without doubt, that the carbon passes to the gaseous state. Between carbon, gaseous, and hydrogen, we would have, on the contrary, a disengagement of heat.

$\frac{6}{7}$ carbon, gaseous	$\frac{6}{7} \times$ 11,191 =	9,520
$\frac{1}{7}$ hydrogen	$\frac{1}{7} \times$ 34,462 =	4,928
Total		14,448
Actual calorific power		11,853
Difference		2,595

This is the heat of combination of gaseous carbon and hydrogen under atmospheric pressure after deducting 272 units set free by the contraction, as for marsh gas.

The density of olefiant gas being 0.978, a pound of this gas occupies 12.66 cubic feet. It contains—

Carbon	0.857
Hydrogen	0.143

Its total combustion requires 3.43 pounds of oxygen, or 14.85 pounds of air, occupying a volume of 183.85 cubic feet, and contains 11.42 pounds of nitrogen. The combustion produces a mixture of 3.14 pounds

carbonic acid, 1.20 pounds aqueous vapor, and 11.42 pounds nitrogen, the whole occupying 222 cubic feet reduced to 0°.

The theoretical temperature of combustion is—

$$\frac{11{,}858}{5.14 \times 0.22 + 1.29 \times 0.48 + 11.42 \times 0.244} = 2{,}894° \text{ C. } (sic)\ (5.241° \text{ F.}).$$

As this is above the limit of dissociation, the actual temperature is about 1,700° C. (3,092° F.), as in the preceding cases.

The volume of the gases produced, raised to this temperature, is more than 1,300 cubic feet. We find then that, having an admission pipe for gas of 0.1 diameter, the air ring should be 0.40 on the outside, and the belly 0.98. The disproportion of dimensions is still greater here than with marsh gas, on account of the density of the gas used. Besides the flame elongates still more by reason of the probable decomposition we have cited. This gas would then be a good one for heating large furnaces, if it were not rare even in illuminating gas.

[To be Continued.]

[Prepared for the JOURNAL.]

A Practical Illustration of the Working of a Large Gas Engine.

By MR. ERNEST F. LLOYD, of Fort Wayne, Ind.

I find the Progressive Age, of April 15th, reproduced the letter you kindly published on April 5th, and also commented upon it. From the character of its remarks and misconstrued inferences I prefer to let it have the last word. The controversy may rest upon its merits, which time will develop, even if they are not already clear; but as many gas engineers and electricians are exceedingly desirous of information on the gas engine, particularly of the larger sizes, and in that they look for it to a considerable extent in the technical papers, is my excuse for again trespassing upon your space.

The editorial in question is (as I consider was also its predecessor to which I objected) a backward step in gas engine literature. It harms the gas industry as much as the gas engine business, and having been in a measure the occasion, I feel called upon in their defence.

It is the province of every engineer to obtain a required result with the most direct and economical means within his reach, and each elimination of superfluous detail is considered a forward step; to this rule the gas engineer is no exception. It would probably be impossible to state in a paragraph the present trend of theoretical gas engine thought—if I may be permitted the expression; but it is I think admitted, first, that the "Otto cycle," so-called, is the present most economical, practical method of obtaining power from gaseous fuel, and has accordingly been universally adopted for all, save perhaps a few small units. Second, that as the size of the gas engine increases the mechanical difficulties multiply.

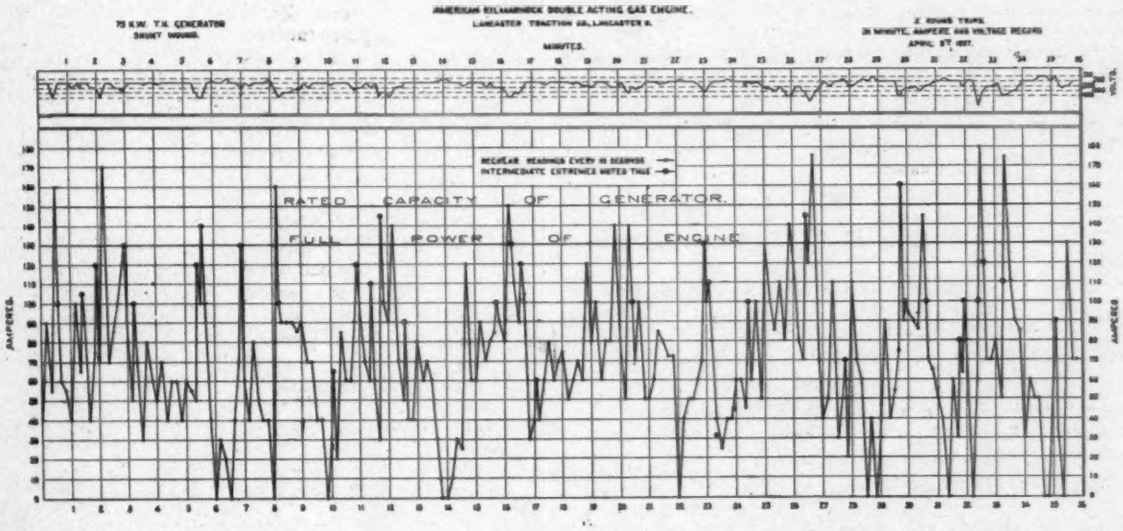
The paper[1] read by me before the Ohio Association set forth the difficulties in the way of increasing the size of single acting gas engines, which have thus far limited them to about 75-horse power in one cylinder, and also showed that double action, in single cylinder type, increased the limit of size to not less than 300-horse power, or at least four times.

The drift of such portions of the editorials of your contemporary, which were of technical interest, was to the effect that this is incorrect; and also, that double action does not materially assist government.

The most severe duty facing the gas engine to-day is electrical. With single-acting engines, sundry methods are adopted to secure regulation—multiple cylinders, high speed, jackshaft balances, disc wheels on dynamos, storage batteries, etc., etc.—which are all possible with small powers and comparatively uniform load.

The double acting engine is sufficiently in advance, outside of its increased practicable sizes, to dispense with all such intermediate aids to regulation. Using much lighter fly wheels on the engine proper with moderate speed, it yet produces a very satisfactory regulation under the most severe conditions, as shown by a load curve (see diagram) which I herewith send you.

This curve is strictly one of average working. The engine from which it was taken is the one previously referred to as being installed at Lancaster, Ohio, and is rated at 130 indicated horse power, at 180 revolutions per minute. It has been in constant operation for 10 months, 18 hours daily, furnishing power for the local street railway. The generator is a shunt-wound, T.H. 75 K.W. machine, direct belted from the engine flywheel. The readings were taken off by the Superintendent, Mr. Frank E. Ginn, and his assistants, and cover a period of 36 minutes, being two round trips of three cars.



The volt and ampere meters were read simultaneously at 10 second intervals, the extreme intermediate variations being sometimes noted on both. Where such occur they are indicated by a circle around the reading of the ampere curve.

While the engine and its electrical governor complement each other, yet the latter is probably to be as much credited with the resultant regulation as is the double action in the engine itself. It will be observed that its command of the engine on a throw-off of the load is absolute, the voltage rise, which appears to be largely due to the discharge from the generator, never exceeding 1 per cent. The extreme drops also are all where the load is beyond the full rated power of the engine and generator. It is to be borne in mind that gas engines, unlike steam, will not sustain an overload. Of the variations within the engine's power it will be seen that they do not exceed 2 per cent. total, and on a steady lighting load would be very much less.

It would probably be difficult to find more severe service, and it would be of much interest if some of your readers, operating steam driven plants under approximating conditions, would record and publish a similar curve.

As for durability, the 10 months' constant operation at Lancaster develops no indication that the engine will not be fully as durable as the smaller sizes have proven. It uses natural gas entirely.

The engine is now offered, and properly guaranteed in sizes up to 200-horse power, in single cylinder, and 600-horse power in tandem cylinder type, and no "genuine inquiry for a 200-horse power" need vainly go "the rounds of the gas engine makers." That inquiry, by-the-way,

1. See JOURNAL, Feb. 15, p. 342.

reached Fort Wayne in the shape of a telegram, and, upon details being asked, no more was heard of it.

It may be added that tandem engines will necessarily regulate much closer than single cylinder, receiving at full load an impulse *every stroke*, each of which is but one-fourth the strength of the impulse in a single acting engine of equal power.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. W. S. RATHELL has, by resignation, closed a satisfactory period of service with the Cairo City (Ills.) Gas Company, of which corporation he became Superintendent July 26th, 1892. He leaves Cairo City to accept charge of the manufacturing and distributing branches of the business of the Decatur (Ills.) Light, Heat and Power Company.

AT the annual meeting of the Hanover (Pa.) Gas Company the officers chosen were: Directors, A. W. Eichelberger, Reuben Young, R. M. Wirt, H. Y. Sprenkle, Stephen Keefer, L. F. Melsheimer and George N. Forney; President, A. W. Eichelberger; Treasurer, George N. Forney.

THE new purifying and condensing plant of the Fitchburg (Mass.) Gas and Electric Company will be housed in two brick buildings, one of which will be 70 feet by 35 feet, the other to have the dimension of 50 by 22 feet. Each is to have a height of two stories. Messrs. S. S. & H. H. Lawrence have the contract for the mason work. The condensing and purifying apparatus will be installed during the summer—we believe a new exhauster is also to be put in line—Mr. Coggshall's purpose being to have the new apparatus ready for use towards the close of November.

A CORRESPONDENT forwards the following: "Superintendent R. D. Wirt has fitted up for the Independence (Mo.) Gas and Coke Company and the Independence Water Company as well, one of the handsomest offices in Independence. It is situated on the first floor of the west room of Music Hall block, which room has been divided into suitable spaces by means of partitions for the purposes of the Companies named. The scheme includes a well appointed apartment for the display of gas cookers, heaters, improved burners, etc. The office furniture is of oak, and the ceiling and wall trimmings are in harmony with the furniture The oak effect is also carried out in the colorings of the carpet floor coverings. Private offices and storerooms are also arranged for."

A RESOLUTION, recently introduced in the Windsor (Ontario) City Council, by Ald. Dixon, modifying the city by-law, which directed that the Windsor Gas Company should lay only cast iron pipes in the streets, has been enacted. Under the revision the Company may lay cast, wrought or steel pipes, on main or service account.

THE Dodge City (Kas.) Water, Gas and Electric Light Company has been incorporated by Messrs. George M. Myers, John Hoore, George G. Gilbert and John P. Loomas, with a capital of $50,000.

THE Councils of Philadelphia are engaged in an attempt to compel the proprietors of the Northern Liberties Gas Company of that city to reduce the selling rate.

MESSRS. DUNCAN R. SLOAN and Isaac Bradburn are named as the principals in the project to establish a gas plant in Lonaconing, Md., a franchise for which was recently indorsed by the Mayor and the Council.

MR. PIERRE M. PAPIN, one of the original projectors of the Laclede Gas Company, of St. Louis, Mo., died at his home in St. Louis, something over a fortnight ago. He was born in St. Louis, in 1823. His wife and six children survive him.

THE annual election of the Cincinnati (Ohio) Gas Light Company resulted in the naming of the following Directors: A. Hickenlooper, Robert Allison, J. H. Bates, W. A. Goodman, A. Howard Hinkle, Chas. Fleischmann and George N. Stone. The Directors subsequently perfected the following organization: President, A. Hickenlooper; Secretary, H. W. Sage.

AT the annual meeting of the South Side Gas Company, Pittsburgh, Pa., the Directors chosen were: George Trautman, Mark Maloney, George W. Elkins, W. A. Heyl, Joseph G. Walters, William H. Alldred, Remsen Messler, Robert B. Brown and Samuel T. Bodine.

THE annual meetings of the Companies in what was known as the Chicago Gas Trust, have been postponed to Thursday, June 3d.

MR. ALBERT M. BARNES has been named to succeed the late Mr. Adolph Vogl as Treasurer of the Cambridge (Mass.) Gas Light Company.

THE proprietors of the Catasauqua (Pa.) Electric Light and Power Company, writing to the JOURNAL under date of the 10th inst., say: "For the information of the readers of your JOURNAL, we beg to advise you that the Catasauqua Gas Company is now controlled and managed by the Catasauqua Electric Light and Power Company. Both concerns still retain their individuality, but are controlled from the office of the Electric Light Company, Mr. Frank M. Tait, formerly Superintendent of the latter Company, being in charge of both plants."

THE Supreme Court has dismissed the appeal of the Ottawa (Can.) Gas Company against the assessing of its mains for purposes of rating on account of taxation by the local authorities.

AT a meeting of the Directors of the Buffalo (N. Y.) Gas Light Company the following resolutions on the death of the Hon. Elbridge Gerry Spaulding, who for 25 years had been President of the Board, were adopted:

"*Resolved*, That in the death of our distinguished friend and associate in business we have sustained a personal bereavement. Mr. Spaulding possessed such a rare combination of transcendent qualities as readily made him a leader, not only among the great men of the State of New York, where most of his life was spent, but in the councils of the Nation.

"When war was desolating our country and the finances of the Nation were on the verge of ruin, his great financial experience and his wise counsel suggested the financial method which puzzled the wisest statesmen and saved the Nation from bankruptcy, and furnished it the means to carry on to success the greatest war of modern times, and earned for himself the proud appellation of 'Father of the Greenback.'

"Mr. Spaulding enjoyed the esteem and affection of all who knew him, not only those immediately connected with him in business, but all capable of appreciating his dezerts. Throughout his long and remarkable business career the breath of suspicion was never cast upon his personal honor. He was a man of the most inflexible integrity, with the fairest reputation derived from a long life without a blemish. His wonderful success in business was the natural product of his sturdy, self-reliant character and sound business judgment.

"*Resolved*, That this expression of our estimate of the character of the deceased, whose memory we shall always revere and whose friendship in life we shall always esteem a great honor, be suitably engrossed by the Secretary, and sent to the family with our deep sympathy."

AT a meeting of the employees of the Buffalo Company, the following resolutions respecting the memory of President Spaulding were adopted:

"*Resolved*, That we deeply mourn the death of our honored President, the Hon. E. G Spaulding, whose long connection with the Company, his great interest in the works, his unaffected manners when with us, his gentle, kindly nature, his great sympathy in times of distress, joined us to him in a league of friendship, and we shall ever cherish his memory with the most profound gratitude.

"*Resolved*, That as a token of our great esteem for the deceased that we attend his funeral in a body."

AT a special meeting of the Directors of the Buffalo Gas Light Company, Mr. E. R. Spaulding was elected President of the Board, succeeding his father, the late Mr. E. G. Spaulding.

THE proprietors of the Southbridge (Mass.) Gas and Electric Company have declared a dividend of 2½ per cent.

AT the annual meeting of the Putnam (Conn.) Gas Company the following officers were elected: Directors, J. W. Manning, A.W. Bowen, G. A. Hammond, Prescott Bartlett, G. H. Brown, O. La Rue and Thos. P. Botham; President, G. A. Hammond; Secretary and Treasurer, A. W. Bowen.

AT the annual meeting of the Matawan and Keyport (N.J.) Gas Company a dividend of 3 per cent., payable June 1st, was declared. The Directors elected were: A. M. Brown and A. Salz, of Keyport, and Wm. V. Clark, Wm. L. Terhune, Henry S. Little, T. Burrowes and James H. Horner, of Matawan. The Directors organized by electing the fol-

lowing executive management: President, Thos. Burrowes; Vice-President, W. L. Terhune; Secretary and Treasurer, James H. Horner.

A CORRESPONDENT at Detroit, writing to the JOURNAL, under date of the 10th inst., says: "The Windsor (Ont.) Gas Company has chosen the following officers for the ensuing year: President, Col. Jerome Croul; Vice-President and Treasurer, I. C. Baxter; Secretary, J. G. Leggatt; Managing Director, J. T. Lynn. Colonel Jerome Croul, the newly-elected President, as you and many of your readers know, is an able, courteous and well-known Detroit business man, who, for many years, has been an active member of the Western Gas Association and of the American Gas Light Association. For a long period of time he was the Managing Director of the old Detroit Gas Company, in which capacity he amply demonstrated his ability to direct the affairs of the Windsor Company in a creditable and successful manner. In fact, the Windsor Company is to be congratulated over securing the services of such a man to look after its interests as the genial, whole-souled Colonel Croul; and I make no mistake in saying that its affairs will be administered by them in a liberal and progressive way.—J."

The Consolidated Gas Company, of Baltimore, Md., will pay a semi-annual dividend of 2½ per cent. on June 1st. This is a decrease of one-quarter per cent. for the half year.

AMONG contracts for bench construction and renewals of benchwork recently secured by the Parker-Russell Mining and Manufacturing Company, of St. Louis, are the following: 26 benches of eights, for the Cincinnati Gas Light and Coke Company; 20 benches of sixes, for the Consumers Gas Company, of Toronto, Ont.; 6 benches of sixes, for the Hamilton (Ont.) Gas Light Company.

THE Domestic Gas Plant Company, of Milwaukee, has filed articles of incorporation. The purpose of the Company is to deal in "gas and gas appliances for light and heat." The Company is capitalized in $100,000, and the incorporators are L. D. Dorschel, J. H. Woodworth, George F. Ransom and George F. Ransom, Jr.

THE Massachusetts Legislature has refused to sanction the measure which proposed to limit the per cent. of carbonic oxide allowable in merchantable gas at 16 per cent.

AT the annual meeting of the shareholders in the Coatesville (Pa.) Gas Company the officers chosen were: Directors, W. B. Mendenhall, L. G. McCauley, Richard Strode, W. H. Gibbons, A. F. Huston, H. J. Branson and Chas. Hewes; President, Chas. Hewes; Secretary and Treasurer, H. J. Branson.

THE automatic charging and discharging equipment in the coal gas section of the Philadelphia gas works is to be increased.

THE proprietors of the Pawtucket (R. I.) Gas Company have determined to erect a new gasholder on their Central Falls site, the contract for the construction of which has been awarded to Messrs. Bartlett, Hayward & Co., of Baltimore. The holder, which will have a working capacity of about 510,000 cubic feet, is to be of the double lift order, with a dimension of: Inner section, 110 feet diameter, by 27 feet in height, outer section, 112 feet diameter, by 27 feet; tank (of steel), 114 feet 6 inches diameter, by 27 feet 9 inches deep. Steel will be used in the holder plating. This holder will put the Company in easy position to supply the city of Pawtucket with gas at normal pressure during the times of heaviest consumption, which has not been its portion for the past few years. The output at Pawtucket has increased greatly since the selling rate was lowered to $1.15 per 1,000, and Manager McGregor and his associates have been greatly handicapped in meeting the demand through lack of holder capacity—the maximum daily sendout last winter virtually reached the 600,000 cubic feet mark. The holder will be arranged for 20-inch connections.

THE projectors of the Newport News (Va.) gas enterprise have again applied for a franchise. The main man in this resuscitation is said to be Mr. William J. Payne, of Richmond, Va.

THE Legislature of Connecticut has, in accordance with the recommendation of the Committee that considered the matter, denied the petition of the Citizens' Gas Company, of Bridgeport, for an amendment to its charter permitting it to distribute an illuminating as well as a fuel gas. The cobbler must stick to his last.

AT the annual meeting of the Providence (Pa.) Gas and Water Company the officers chosen were: Managers, W. F. Hallstead, W. H. Storrs, A. H. Vandling, F. F. Torrey and C. S. Weston; President, W. H. Storrs; Secretary and Treasurer, H. F. Atherton; General Superintendent, J. B. Fish.

COMMON sense prevailed in the Common Council of Amsterdam, N. Y., when it rejected the petition of the projectors of the Citizens Gas Light and Fuel Company to operate an opposition gas works in that city.

IT is said that negotiations are underway which have for their object the consolidation and change of ownership of the gas and electric lighting interests of Cicero, Ills.

WORK will shortly be commenced on the new holder for the Fall River (Mass.) Gas Company. Messrs. Bartlett, Hayward & Co. are to build it. It is to be of the 3-lift order, with a rated capacity of 750,000 cubic feet, and will be located on a site secured by the Company, at the corner of Anawan and Pond streets.

A CORRESPONDENT forwards the following: "A very important decision was recently rendered by the Colorado Supreme Court, which decison pertains to the case of the city of Leadville vs. the Leadville Illuminating Gas Company. A *resume* of the case is this: In the Court of Appeals the Leadville Illuminating Gas Company secured a reverse of the judgment obtained against it by the city of Leadville, and the case was remanded to the District Court of Lake County. In the opinion of the Court of Appeals, prepared by Judge Wilson, it was not necessary to make an appropriation to meet the certain expense incurred by order of the city. Some time after the city had entered into a contract with the Company to light the city, the city requested the Company to maintain and keep in repair the street lamps and posts, and contracted to reimburse it therefor. The Company fully complied on its part with the terms of the contract, but the city has failed for a number of years to pay the Company. Judge Wilson remarked: 'The lighting of a city is a permanent necessity for the comfort, convenience and protection of its citizens in their persons and property. It is also a matter of general knowledge that it requires a large expenditure of money to establish the required plant and facilities for furnishing the light. If a city were not allowed in such a case to contract for light for some reasonable length of time, and the individual or company furnishing light was compelled to trust for his compensation from year to year to the varying moods of city councils, it is safe to say that no one would engage in such a hazardous enterprise. A city then must furnish its own light, which is most frequently deemed inadvisable—at least in the smaller cities and towns—or remain in darkness. This contract was for a period of 25 years, from August, 1879, for which length of time the city had express authority of law to execute it.'"

MR. T. S. CLEMINSHAW has resigned the position of Engineer to the Launceston (Tasmania) Gas Company, which place he filled for many years with credit to himself and with profit to his employers. His new address is "Care Messrs. J. Terry & Co., 7 Great Winchester street, London, E.C., England."

ONE of the most interesting displays of the Tennessee Centennial Exhibition is that made by the Nashville Gas Company. We hope to explain it in detail later on.

AT the annual meeting of the Easton (Pa.) Gas Company the officers chosen were: Directors, G. M. Odenwelder, E. S. Lawall, E. M. Fox, Samuel Boileau and W. G. Stewart; President, S. Boileau; Secretary, W. G. Stewart; Treasurer, E. S. Lawall; Superintendent, Wm. H. Ward.

MR. A. D. MEEDS, official gas inspector for the city of Minneapolis, Minn., in the report of the operations of his department for the year ended December 31, 1896, has this to say about the inspection of gas meters: "The number of gas meters inspected during the year was 91, of which 85 were from the city and 6 from the city of Waterloo, Iowa. Of the 85, 43 were from service, inspected upon complaint of gas consumers. Of the 43 meters from service, 15, or about 35 per cent., were condemned, 11 for exceeding 2 per cent. fast, 1 for exceeding 2 per cent. slow, and 3 were condemned for other reasons. The fastest meter was found 16 per cent. fast, and the slowest was 4 per cent. slow. The average of the 85 meters tested was .43 per cent. fast, and the average of the 43 meters from service was 1½ per cent. fast. This is a little better showing than last year. The system adopted by the Minneapolis

(*Continued on page 770.*)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

The JOURNAL is the official organ of the
NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
AMERICAN GAS LIGHT ASSOCIATION.
WESTERN GAS ASSOCIATION.
OHIO GAS LIGHT ASSOCIATION.
PACIFIC COAST GAS ASSOCIATION.
TEXAS GAS AND ELECTRIC LIGHT ASSOCIATION.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 Cents.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, MAY 17, 1897.

(*Continued from page* 769.)

Gas Light Company, of changing a meter every three years, is calculated to keep the meters in service pretty nearly accurate within the legal limits. In many cases, however, certain conditions prevail that tend to make a meter register inaccurately after being in service less than the three years allowed. A very hot, dry place tends to dry up and shrink the diaphragms in the meter, causing it to register too fast; whereas, in a cold place a contraction takes place, also resulting in the meter registering too fast."

A New Gas Engine Cycle.

The London *Journal* notes that Mr. Tremlett Carter has been working out the details of a new gas engine cycle, which he has invented, and which is designed to effect improvements where the Otto cycle is principally defective. These developments were completed some two months ago, and were then protected by patents, it being intended to acquire further foreign patents immediately. The principal improvements in the Otto cycle which this new cycle is directed to effect are, 1st, the useful recovery of heat wasted in the jacket and exhaust, which in the Otto cycle is represented by some 70 to 80 per cent. of the total heat; 2d, the abolition of the idle revolution, without the use of two working cylinder ends, and without the use of a pump for compressing the explosive mixture; 3d, an increase in the power obtained from a given sized cylinder; 4th, the prompt and efficient regulation without omission of explosions; and 5th, a means of increasing the power of the engine considerably beyond the normal, to enable it to take extra heavy loads for short intervals. The consumption of gas by an engine working on the new cycle is expected to be 50 to 60 per cent. only of one with the Otto cycle.

The Market for Gas Securities.

The market for listed stocks has been largely in the hands of professional traders during the week, and the net results, so far as listed city gas shares is concerned, is a net decline in Consolidated of 3½ points. There is no good reason for this shrinkage in values; in fact, there is good reason why the stock should be selling at 175. Other city shares, however, are notably strong, particularly Equitable and Standards. The common of the latter is bid 104½, and the preferred is 120 to 123. Mutual is nominally lower, at 245 bid, with the reported offering price of 255. The real fact is that a round lot of 100 shares could not be purchased at anything under 260. New York and East River common also maintains its advance. The developments in the business of gas supply in New York this summer will be more than momentous, despite the assertions of the "directors" that nothing at all of importance is even being considered. We advise the purchase of any class of shares on the list, at the market, for a good round profit, in comparatively short time.

Brooklyn Union is 106¾ ex. div., and it will go higher; the bonds are 111½ bid. Bay State gas is dull and lower, and Chicago gas is weaker on the thought that the proposed laws permitting consolidation there to be perfected will fail of passage. Baltimore Consolidated is 59½ to 59¾, which shows that the cutting of the semi-annual dividend to 2½ per cent. from 2½ per cent. had been discounted. The Company is to be congratulated on the conservative commonsense of the management which prompted the action taken. It also should go to show that the price of gas in Baltimore is not excessive.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

MAY 17.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	161	161¼
Central	500,000	50	195	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	215	220
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	245	255
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	85	
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	59	61
Preferred	2,000,000	100	97	97¾
Bonds 1st 5's	3,500,000	1,000	110	110½
" 1st Con. 5's	1,500,000	..	103¾	103
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	104¼	103½
Preferred	5,000,000	100	120	123
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	113
Yonkers	299,650	50	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	106¾	107¼
" " Bonds (5's)	15 000,000	1,000	111¼	..
Bay State	15,000,000	50	9⅝	9¾
" Income Bonds	2,000,000	1,000	..	85
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	85
2d " " "	3,000,000	1,000	70	72
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	96	..
Chicago Gas Co.	25,000,000	100	81⅛	81¼
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	72	74
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	75	80
" Bonds	600,000	1,000	100	101*
Cincinnati G. & C. Co.	8,500,000	100	201¾	202
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	85
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	59¼	59¾
Mortgage, 6's	3,600,000	..	107	107⅛
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	22	..
" Con. Bonds	4,312,000	..	73½	74
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	81	83
" Bonds	2,000,000	..	89	92
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	132	135
" Bonds, 6's	2,650,000	..	106¾	107⅛
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	84	88
Bonds	1,000,000	1,000	92	95
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	22	23¼
Preferred	2,500,000	100	73	79
Bonds	9,084,400	1,000	95	95¼
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	98	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53¼	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	300,000	50	..	175
Rochester Gas & Elec. Co.	2,150.000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10,000,000	100	94	94¼
St. Paul Gas Light Co.	1,500,000	100	79	81
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	.
Western, Milwaukee	4,000,000	100	65	67
Bonds, 5's	3,556,000	..	94	95½
Wilmington, Del.	550,000	50	200	202

*Ex-interest.

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	791
Fred. Bredel, Milwaukee, Wis.	776
Geo. R. Rowland, New York City	791
The Western Gas Construction Co., Fort Wayne, Ind.	782
Humphreys & Glasgow, New York City	778
T. G. Lansden, St. Louis, Mo.	791
American Gas Co., Phila., Pa.	776
David Leavitt Hough, New York City	793
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	789

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	789
United Gas Improvement Co., Phila., Pa.	781
Burdett Loomis, Hartford, Conn.	790
National Gas and Water Co., Chicago, Ills.	788
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	789
The Western Gas Construction Co., Fort Wayne, Ind.	782
Humphreys & Glasgow, New York City	778

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	792
Continental Iron Works, Brooklyn, N. Y.	790
Deily & Fowler, Phila., Pa.	792
Kerr Murray Mfg. Co., Fort Wayne, Ind	788
Stacey Mfg. Co., Cincinnati, Ohio	791
Bartlett, Hayward & Co., Baltimore, Md.	789
Davis and Farnum Mfg. Co., Waltham, Mass.	788
R. D. Wood & Co., Phila., Pa.	790
Isbell-Porter Company, New York City	790
Fred. Bredel, Milwaukee, Wis.	776
United Gas Improvement Co., Phila., Pa.	781
Berlin Iron Bridge Co., East Berlin, Conn.	778
National Gas and Water Co., Chicago, Ills.	788
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	789
The Western Gas Construction Co., Fort Wayne, Ind.	782
Humphreys & Glasgow, New York City	778
Gas Engineering Co., Pittsburgh, Pa.	788
American Gas Co., Phila., Pa.	776
Logan Iron Works, Brooklyn, N. Y.	792
Riter & Conley, Pittsburgh, Pa.	775

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City..... 791
R. D. Wood & Co., Phila., Pa..... 790
James R. Floyd & Sons, New York City 792
Continental Iron Works, Brooklyn, N. Y..... 790
Gas Engineering Co., Pittsburgh, Pa..... 788
Logan Iron Works, Brooklyn, N. Y..... 792
Riter & Conley, Pittsburgh, Pa..... 775
Kirkham, Hulett & Chandler, London, Eng..... 772

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md..... 780
Fred. Bredel, Milwaukee, Wis..... 776
J. H. Gautier & Co., Jersey City, N. J..... 786
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 786
Adam Weber New York City 786

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City..... 791
R. D. Wood & Co., Phila., Pa..... 790

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich..... 772
G. Shepard Page's Sons, New York City 791
Gas Engineering Co., Pittsburgh, Pa..... 788

GAS METERS.

John J. Griffin & Co., Phila., Pa..... 796
American Meter Co., New York and Philadelphia..... 795
Helme & McIlhenny, Phila., Pa. 796
D. McDonald & Co., Albany, N.Y..... 795
Nathaniel Tufts, Boston, Mass..... 794
Maryland Meter and Mfg. Co., Baltimore, Md..... 794
Metric Metal Co., Erie, Pa..... 794
Keystone Meter Co., Royersford, Pa..... 794
Buhl Stamping Company, Detroit, Mich..... 795

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia 795
John J. Griffin & Co., Phila., Pa..... 796
D. McDonald & Co., Albany, N. Y..... 795
Helme & McIlhenny, Phila., Pa..... 795

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio..... 793
M. J. Drummond, New York City..... 793
R. D. Wood & Co., Phila., Pa..... 790
Warren Foundry and Machine Co., New York City..... 793
Donaldson Iron Co., Emaus, Pa..... 793

PIPE CUTTERS.

The Anderson Pipe Cutter Co., Marlboro, Mass..... 775

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y..... 783

GAS COALS.

Penn Gas Coal Co., Phila., Pa..... 785
Perkins & Co., New York City 784
Despard Gas Coal Co., Baltimore, Md..... 785
Westmoreland Coal Co., Phila., Pa..... 785
Berwind-White Coal Mining Co., New York and Phila.. 784
Althouse & Kennedy, Phila., Pa..... 785

CANNEL COALS.

Perkins & Co., New York City 784
Althouse & Kennedy, Phila., Pa..... 785

GAS ENRICHERS.

Standard Oil Co., New York City 785
The Sun Oil Co., Pittsburgh, Pa..... 785

COKE CRUSHER.

C. M. Keller, Columbus, Ind..... 785

CONVEYING MACHINERY.

C. W. Hunt Company, N. Y. City 773

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 772

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 783
Isbell-Porter Co., New York City..... 790
The Wilder Mfg. Co., Phila., Pa..... 775
R. D. Wood & Co., Phila., Pa..... 790

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City..... 90
Continental Iron Works, Brooklyn, N.Y..... 790
G. Shepard Page's Sons, New York City..... 791
Logan Iron Works, Brooklyn, N. Y..... 792
R. D. Wood & Co., Phila., Pa. 790

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N.Y..... 786

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J..... 786
B. Kreischer & Sons, New York City..... 786
Adam Weber, New York City..... 796
Laclede Firebrick Mfg. Co., St. Louis, Mo. 786
Cyrus Borgner, Phila., Pa..... 786
James Gardner, Jr., Pittsburgh, Pa..... 786
Henry Maurer & Son, New York City..... 786
Baltimore Retort and Firebrick Co., Baltimore, Md..... 786
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 786
Brooklyn Firebrick Works, Brooklyn, N. Y..... 786
F. Behrend, New York City..... 775

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa..... 780

MICA GOODS.

The Mica Mfg. Co., New York City..... 772

BURNERS.

C. A. Gefrorer, Phila., Pa..... 790
Theo. Clough, Dobbs Ferry, N. Y 772

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 772

GAS TUBING.

J. C. Granger, New York City 772

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 783
Greenpoint Chemical Works, Brooklyn, N.Y..... 788
Henry W. Douglas, Ann Arbor, Mich 783

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind 777
Isbell-Porter Company, New York City..... 790
Connelly Iron Sponge and Governor Co., New York City 783

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y. 782
Chapman Valve Manufacturing Co., Boston, Mass..... 782
R. D. Wood & Co., Phila., Pa..... 790
Continental Iron Works, Brooklyn, N. Y..... 790
The P. H. & F. M. Roots Co., Connersville, Ind..... 777
Isbell-Porter Co., New York City..... 790
The Western Gas Construction Co., Fort Wayne, Ind.... 782

ELECTRICAL APPARATUS.

Wm. Henry White, New York City 791

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa..... 736
The American Gas Engine Co., Phila., Pa 787
Backus Water Motor Co., Newark, N. J..... 788

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City..... 772
W. G. & G. Greenfield, East Newark, N. J..... 788

PURIFIER SCREENS.

John Cabot, New York City..... 773

GAS STOVES.

American Meter Co., New York and Philadelphia..... 779
Maryland Meter and Manufacturing Co., Baltimore, Md. 794
Keystone Meter Co., Royersford, Pa..... 794
A. Weiskittel & Son, Baltimore, Md..... 775
Detroit Stove Works, Detroit, Mich..... 774

GASHOLDER PAINT.

New York Marine Paint Co., Poughkeepsie, N. Y..... 782

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y..... 782

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 780
Continental Iron Works, Brooklyn, N. Y..... 790
Delly & Fowler, Philadelphia, Pa. 792
Davis & Farnum Mfg. Co., Waltham, Mass..... 788
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 788
Stacey Mfg. Co., Cincinnati, Ohio..... 791
R. D. Wood & Co., Philadelphia, Pa..... 790
Logan Iron Works, Brooklyn, N. Y..... 792
Riter & Conley, Pittsburgh, Pa..... 775

GAS SECURITIES.

Gustavus Maas, New York City..... 772
Marquand & Parmly, New York City..... 772

Position Desired

As Superintendent of Gas Works or Gas and Electric Light Works,

By a man 34 years of age. Sixteen years' experience in the manufacture and distribution of Coal Gas as Supt., and four years in the Electric line. Thoroughly competent to take charge of any plant, separately or combined. A practical mechanic, and understands the erection of gas plants and everything pertaining to the business. Not afraid of work. Salary no object until ability is proven. Best of references.

1109-tf Address "M. E. J.," care this Journal.

WANTED,

A man with some experience in the gas business as

Assistant Superintendent

in a works near New York City.

1145-tf Address "G. C.," care this Journal.

WANTED,

Second-Hand Station Meter.

The undersigned Company requires, for auxiliary coal gas plant, Station Meter, capacity 8,000 to 10,000 cubic feet per hour. Full particulars required.

CITY GAS COMPANY,
1145-tf London, Ont.

FOR SALE,

A No. 2 Keller Coke Crusher.

Good as new; only used short time.

COVINGTON GAS LIGHT CO.,
1145-5 Covington, Ky.

FOR SALE.

Hydraulic, Dip, Branch and Ascension Pipes, Mouthpieces and Lids, for four Benches of 5's and for one Bench of 3 retorts.

Two Coolers, or Air Condensers, each of 150 000 cubic feet capacity.

Multitubular Condenser, shell, 36 in. diameter, with 98 2-in. tubes, 10 ft. 6 in. long.

D-Shaped Tar Extractor, 8 ft. long, 1 ft. 6 in. deep.

Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three man holes, 11 in. by 15 in.

S-inch Center Seal. Four Purifiers, 8 ft. x 6 ft.

KEY CITY GAS CO.,
1119-tf Dubuque, Iowa.

FOR SALE,

One 8-Foot Station Meter, with 12-Inch Connections.

In good order and in use. Address

1127-tf NEW HAVEN (CONN.) GAS LIGHT CO.

For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

Address FORT WAYNE ELECTRIC CORPORATION,
1097-tf Fort Wayne, Ind.

GAS COMPANY SECURITIES

A SPECIALTY.

Brooklyn,
Columbus,
Consolidated of New Jersey,
Detroit,
Madison,
Milwaukee,
Grand Rapids,
New York,
Syracuse,
St. Paul.

GUSTAVUS MAAS,

Telephone, 2137 Cortlandt. 26 Broad St., N. Y.

MARQUAND & PARMLY,

160 Broadway, New York.

Members New York Stock Exchange.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

J. C. GRANGER, successor to NICHOLLS & GRANGER

Manfr. of GAS STOVE TUBING.

Guaranteed Best Quality.

PAT. END GAS TUBE.

Patent Portable Tubing.
Speaking Tubing.
Elevator Tubing.

582 to 588 Hudson Street, New York City.

THEO. CLOUGH,

(Established 1870.)

SOLE MANUFACTURER OF THE

Trade Mark Maxim Reg. & Trade Mark Clough Reg. Adjustable Gas Burners

E. H. Nickel Tips for Water Gas a Specialty.

THEO. CLOUGH, - - Dobbs Ferry, N. Y.

BRISTOL'S RECORDING **PRESSURE GAUGE.**

For continuous records of **Street Gas Pressure**

Simple in Construction, Accurate in Operation Low in Price.

Fully Guaranteed. Send for Circulars.

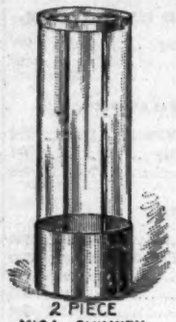
The Bristol Co.,
Waterbury, Conn.

Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.
ALL SIZES AND SHAPES.

D. M. STEWARD MFG. CO.,
CHATTANOOGA, TENN.

Our Mica Chimneys



2 PIECE MICA CHIMNEY.

Etched Chimneys to Order.

For Welsbach Lights ARE THE **BEST IN THE WORLD.**

Get Catalog and Discounts.

The MICA MFG. CO
Micasmiths,
88 Fulton Street, N. Y. City.

The Pioneer Vertical Water-Tube Boiler of the World!

THE HAZELTON OR PORCUPINE BOILER.

After Sixteen Years of Active Service in all the Principal Industries, this Boiler has Proven Itself Superior to all Others in Economy of Fuel, Durability, Safety and General Efficiency.

NO EXPLOSIONS OR ACCIDENTS OF ANY KIND.

Correspondence Solicited.

The HAZELTON BOILER COMPANY,
Sole Proprietors and Manufacturers,

Cable Address, "Paila," New York. Tele., "1229-18th St.," New York. Gen'l Office, 716 E. 13th St., N.Y., U.S.A.

THE Patent "Standard" Washer-Scrubber

(U. S. A. Patent, No. 486,927 of November 29, 1892.)

As in use in most of the principal Gas Works in Great Britain and on the Continent of Europe.

THE FOLLOWING ARE SAMPLES OF TESTIMONIALS RECEIVED, VIZ.:

From MR. A. C. McMINN, Engineer at Kensal Green Station of The Gas Light and Coke Co.

"I have had No. 2 Washer at work and find it as satisfactory as No. 1. I am sending to-day certificate for final payment."

From MR. W. R. CHESTER, Engineer to the Nottingham Corporation.

"The Washer fitted at Basford last year with your new Patent Wood Segments, works well, and I am quite satisfied with it. I propose to have each vessel converted to wood segments, as the iron ones wear out."

FOR PARTICULARS AND ESTIMATES APPLY TO

KIRKHAM, HULETT & CHANDLER, Limited,

PALACE CHAMBERS, WESTMINSTER, ENGLAND.

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired.

553-557 West Thirty-third Street, New York.

We also make the Cheapest and Strongest REVERSIBLE BOLTED TRAYS IN THE MARKET.

Send for Circulars.

G. W. HUNT COMPANY.

COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

INDUSTRIAL RAILWAYS

Specially designed for handling material in and around

Gas Works, Coal Yards, Factories, Etc., Etc.

45 Broadway, N. Y. City.

A CONVENIENT

BINDER for the JOURNAL

STRONG.
DURABLE.
LIGHT.
SIMPLE
CHEAP.
HANDSOME.
Price, $1.

A. M. Callender & Co.,
32 Pine st.,
N. Y. City.

HUGHES' "GAS WORKS,"

Their Construction and Arrangement,

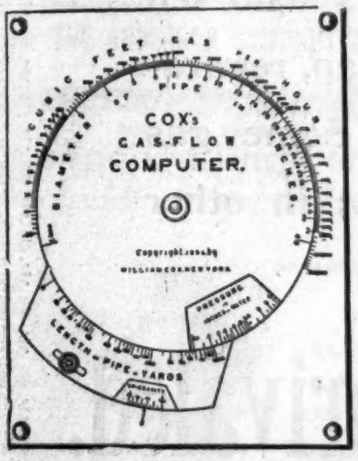
And the Manufacture and Distribution of Coal Gas.

Originally written by SAMUEL HUGHES, C.E.

Rewritten and Much Enlarged by WILLIAM RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements. **Price, $1.65.**

A. M. CALLENDER & CO., No. 32 Pine Street, N. Y. City.



Cox's Gas Flow Computer.

1. It gives at a glance the discharge of gas from pipes 1 to 48 inches in diameter and 10 to 10,000 yds. long, for any pressure from 0.01 to 10.0 inches of water, and any specific gravity from 0.40 to 1.00.
2. When the required discharge and the length of pipe are given, the diameter corresponding to any pressure is at once seen.
3. When the required discharge and the length of pipe are given, the pressure corresponding to any diameter is at once found.
4. Any suitable combination of the different factors of any problem, under all possible conditions, may be immediately found.

It Prevents Errors and Saves Hours of Tiresome Calculations.

Price, $5.00, per Registered Mail.

For sale by

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

PRACTICAL HANDBOOK ON

GAS ENGINES

With Instructions for Care and Working of the Same.

By G. LIECKFELD, C.E.

Translated with Permission of the author by GEO. M. RICHMOND, M.E.

Price, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, New York.

TESTS

Tell the story, and this is the secret of the wide popularity of Detroit Jewels. Tried fairly in competitive tests they never fail to come off winners, easily demonstrating their superiority to other gas ranges in all such matters as economy, utility, convenience, and durability. Such criticisms as are occasionally urged against Detroit Jewels are first voiced by those dealers who sell certain gas ranges because they are cheap, regardless of their general worthlessness. Some gas ranges are slightly cheaper than ours; in other respects

Detroit Jewels Are Unrivaled.

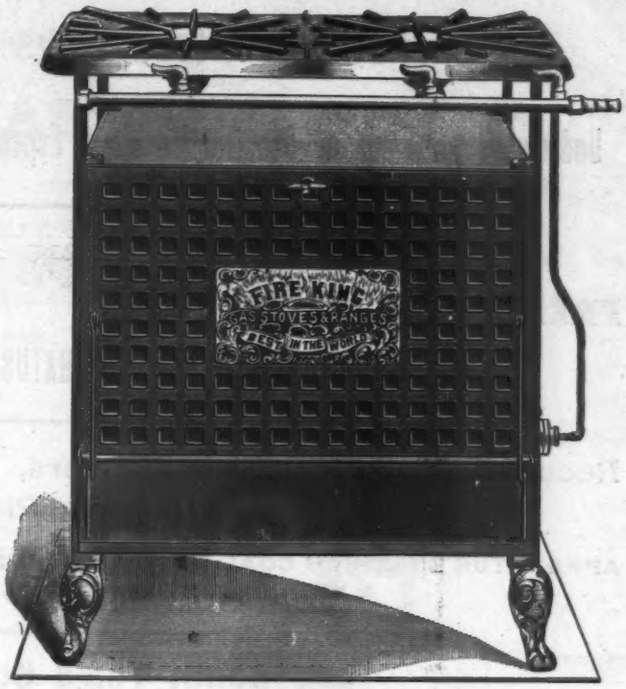
A CATALOGUE WILL TELL YOU ALL ABOUT THEM.

DETROIT STOVE WORKS.

DETROIT. CHICAGO.

LOW PRICED GAS RANGES.

Just the thing for these Hard Times. Will cook for a large family. Write for catalogue and discounts. A full line of all kinds of Gas Stoves and Ranges.



A. WEISKITTEL & SON,
Factory: BALTIMORE, MD.

NEW YORK BRANCH:
1387 BROADWAY, N. Y.

NEW ENGLAND AGENCY:
WALDO BROS., Boston, Mass.

THE ANDERSON Patent Cutter Carrying Link
Made in all sizes.
Will cut from 2 in. to 24 in.
Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.
THE ANDERSON PIPE CUTTER COMPANY, Manufacturers,
293 Lincoln St., Marlboro, Mass.
N. Y. Office, 135 Greenwich St.
C. H. TUCKER, Jr., Manager.
WALDO BROS.,
102 Milk Street, Boston, Mass.

F. BEHREND,
SOLE IMPORTER OF THE CELEBRATED
German (Stettin-Didier) Clay Gas Retorts,
BLOCKS, TILES, FIREBRICKS, FIRE CEMENT,
Stettin "Anchor" & "Eagle" Brand Portland Cement
10 & 12 Old Slip, New York.

THE GREATEST IMPROVEMENT IN GAS LIGHTING
Has been made by
WILDER'S VOLUMETRIC GOVERNORS.
They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.
WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.
THE WILDER MANFG. CO., - - 818 Cherry St., PHILADELPHIA.

RITER & CONLEY, PITTSBURGH, PA.

GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks.

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

AMERICAN GAS COMPANY

Owns, Operates, Buys and Leases Gas Works.

Undertakes all Kinds of Construction Work, Especially for the Manufacture of Gas from Caking Coal.

EASTERN AGENTS FOR

FRED. BREDEL'S SYSTEM
COAL GAS PLANTS AND GAS APPARATUS.

P. H. & F. M. ROOTS CO.'S
Exhausters, Blowers, etc.

Recuperative Furnaces, Washers, Condensers, Purifiers and Purifying Machines, Ammonia Plant, Coke Conveyers, etc,

APPARATUS BY WHICH COAL GAS CAN BE BROUGHT UP TO 22 or 24 CANDLE POWER, MAKING A WHITE LIGHT THAT WILL BURN WITHOUT SMOKING.

222 South Third Street, Philadelphia, Pa.

GEORGE G. RAMSDELL, General Manager. **Correspondence Solicited**

FRED. BREDEL, C.E.

Coal and Water Gas Plants,

OWN SYSTEM.

Recuperative Furnaces, Washers, Condensers, Purifiers, Purifying Machines.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

COMPLETE GAS WORKS, COKE CONVEYERS, ETC.

No. 118 Farwell Avenue, · · Milwaukee, Wis.

Eastern Agents: AMERICAN GAS CO., Construction Department, 222 So. 3d St., Phila., Pa.

P. H. & F. M. ROOTS CO.

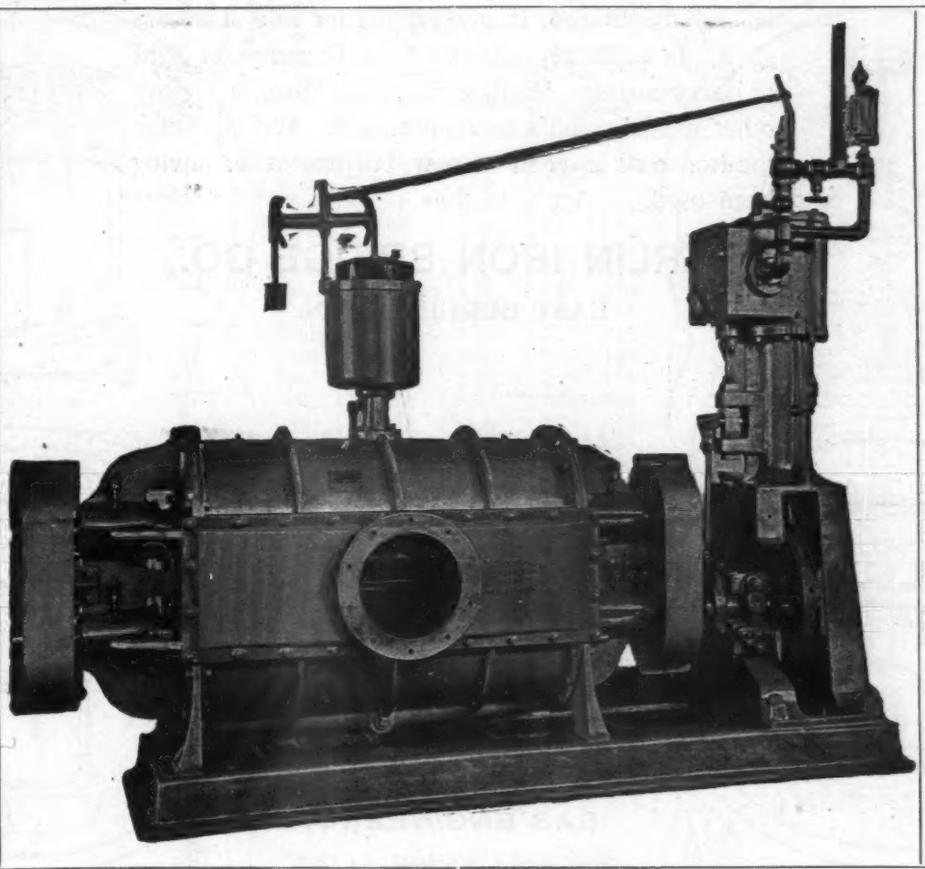
Beg to announce they have completed arrangements by which the

AMERICAN GAS COMPANY,

222 SOUTH THIRD STREET, - PHILADELPHIA, PA.,

Become their Eastern Agents, and will have exclusive control of the territory, embracing New York, New Jersey, Pennsylvania and New England, for the sale of Exhausters and kindred machinery. The New York Office will be continued for the sale of the ROOTS' BLOWER.

New Design of Direct Connected Engine and Exhauster on Same Bedplate.



This Design is Used for all Exhausters from No. 7 to No. 10, Inclusive.

Write for Illustrated Catalogue.

Estimates submitted on application.

P. H. & F. M. ROOTS CO.

Connersville Indiana.

New York Office, 109 Liberty Street. J. B. STEWART. Manager

IRON ROOF FOR SALE.

Width of building, 155 feet out to out, divided into a center span 66 feet, with a wing on each side 43 feet 6 inches. Total length of building, 350 feet. This building is designed with brick sides and gable walls, with Iron roof trusses and Iron supporting columns. Originally built for an Iron Foundry, but, owing to the failure of purchaser, is now offered for sale at a bargain. Is admirably adapted for a Foundry for light or heavy castings, Machine Shop, Car Barn, or for any other general manufacturing purposes. We guarantee the Ironwork as good as new, building never having been used. Apply to the

BERLIN IRON BRIDGE CO.,

EAST BERLIN, CONN.

ALEX. C. HUMPHREYS, M.E., MANHATTAN LIFE BUILDING, (64 BROADWAY,) NEW YORK.

CABLE ADDRESS, LONDON & NEW YORK, "HUMGLAS."

ARTHUR G. GLASGOW, M.E., 9 VICTORIA ST., LONDON, S. W. ENGLAND.

HUMPHREYS & GLASGOW,

CONTRACTING AND CONSULTING

GAS ENGINEERS.

WATER GAS PLANT A SPECIALTY.
GAS PROPERTIES EXAMINED AND VALUED.
ADVICE AS TO IMPROVEMENT OF GAS PROPERTIES AND MANAGEMENT.

THE MANAGEMENT OF SMALL GAS WORKS.

By C. J. R. HUMPHREYS.

Price $1.

A. M. CALLENDER & CO., No. 32 Pine Street New York.

(Copyrighted, 1894, by the AMERICAN METER CO.

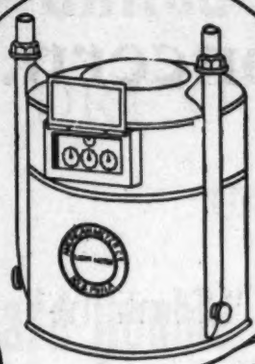
AMERICAN METER CO.

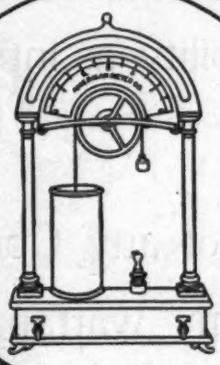
ESTABLISHED 1894. INCORPORATED 1863.

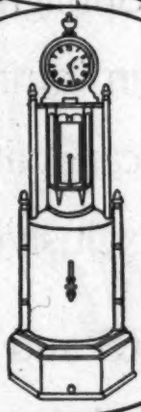
NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.







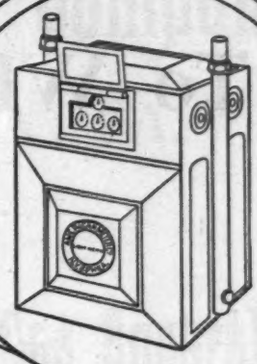
PUBLIC LIGHTING TABLE.

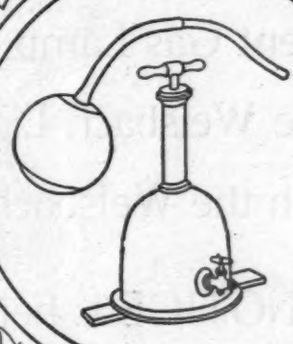
JUNE, 1897.

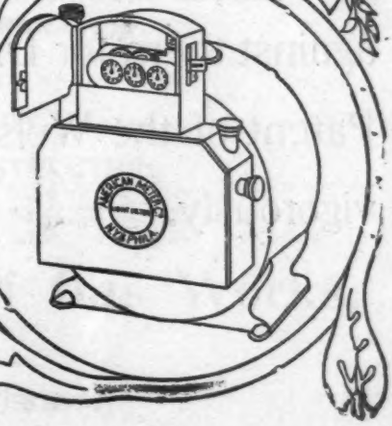
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	7.50 PM	3.30 AM	7.15	3.15
Wed.	2	7.50	3.30	7.15	3.15
Thu.	3	7 50	3.30	7.15	3.15
Fri.	4	9.50	3.30	7.25	3.15
Sat.	5	10.20	3.30	7.25	3.15
Sun.	6	10.40	3.30	7.25	3.15
Mon.	7	11.10 FQ	3.30	7.25	3.15
Tue.	8	11.30	3.30	7.25	3.15
Wed.	9	12.00 AM	3.30	7.25	3.15
Thu.	10	12.30	3.30	7.25	3.15
Fri.	11	1.10	3.30	7.25	3.15
Sat.	12	1.50	3.30	7.25	3.15
Sun.	13	No L.	No L.	7.25	3.15
Mon.	14	No L. FM	No L.	7.25	3.15
Tue.	15	No L.	No L.	7.25	3.15
Wed.	16	8.00 PM	10.30 PM	7.25	3.15
Thu.	17	8.00	11.10	7.25	3.15
Fri.	18	8.00	11.40	7.30	3.15
Sat.	19	8.00	12.00 AM	7.30	3.15
Sun.	20	8.00	12.20	7.30	3.15
Mon.	21	8.00 LQ	12.50	7.30	3.15
Tue.	22	8.00	1.10	7.30	3.15
Wed.	23	8.00	1.30	7.20	3.15
Thu.	24	8.00	2.00	7.30	3.15
Fri.	25	8.00	2.30	7.30	3.15
Sat.	26	8.00	3.30	7.30	3.15
Sun.	27	8.00	3.30	7.30	3.15
Mon.	28	8.00	3.30	7.30	3.15
Tue.	29	8.00 NM	3.30	7.30	3.15
Wed.	30	8.00	3.30	7.30	3.15

TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	233.00	January	423.20
February	187.20	February	355.25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45







To Whom It May Concern.

WE have learned that the makers of the "Sunlight" lamp assert that there has been a decision in the English Courts which saves them and their customers from liability as infringers of the Welsbach patents.

We assure the public there is no decision of any Court, in England or elsewhere, that directly or indirectly warrants the statement or inference that the lamp sold by the Sunlight Incandescent Gas Lamp Company of America is not an infringement of the Welsbach Light as made under the American patents, of which the Welsbach Light Company is sole and exclusive owner.

NOTICE is hereby given to all PURCHASERS and USERS of the so-called "Sunlight" lamp that suits will be brought against them for DAMAGES for INFRINGEMENT of the Letters Patent of the Welsbach Light Company, and will be prosecuted vigorously.

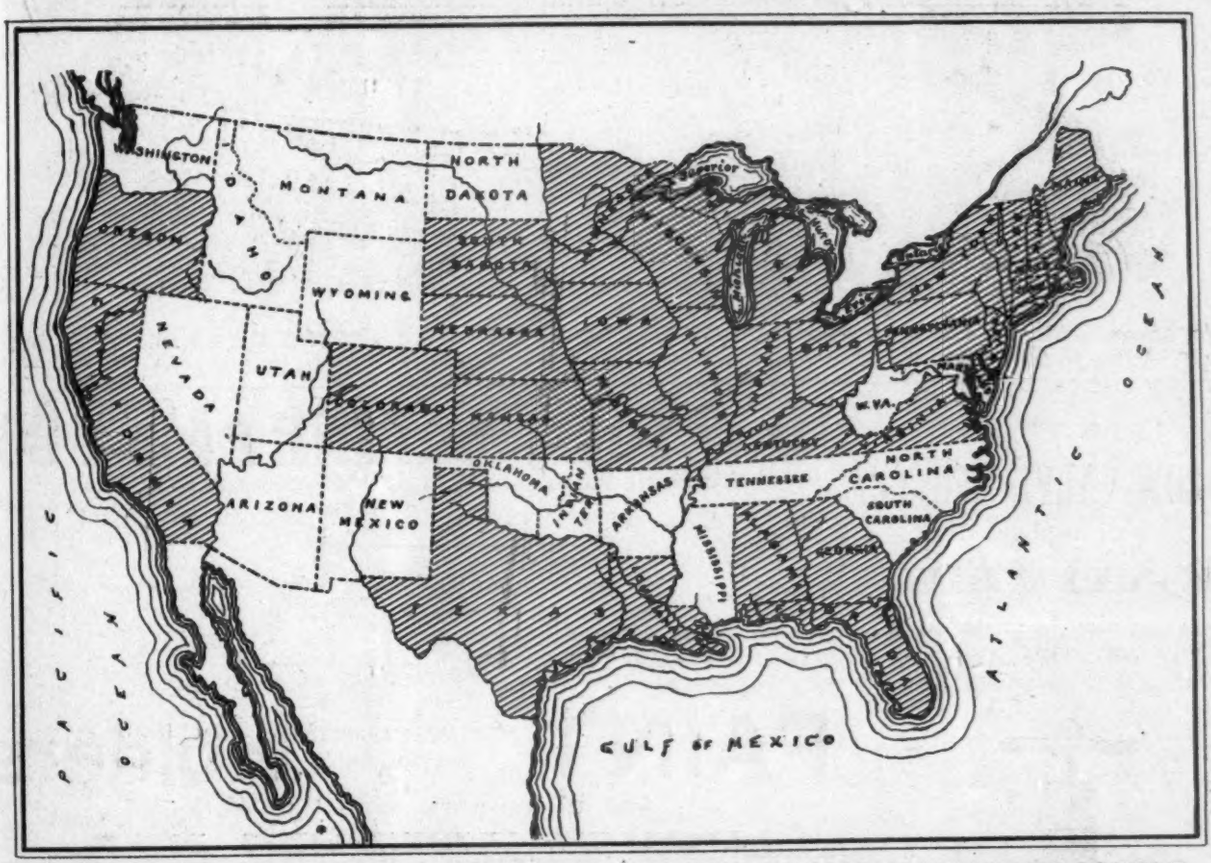
WELSBACH LIGHT COMPANY.

The United Gas Improvement Company,

DREXEL BUILDING, PHILA., PA.

Originators and Builders of the

Standard Double Superheater Lowe Water Gas Apparatus.



SHADING INDICATES STATES IN WHICH HAVE BEEN BUILT THE STANDARD DOUBLE SUPERHEATER AND JUNIOR LOWE WATER GAS APPARATUS.

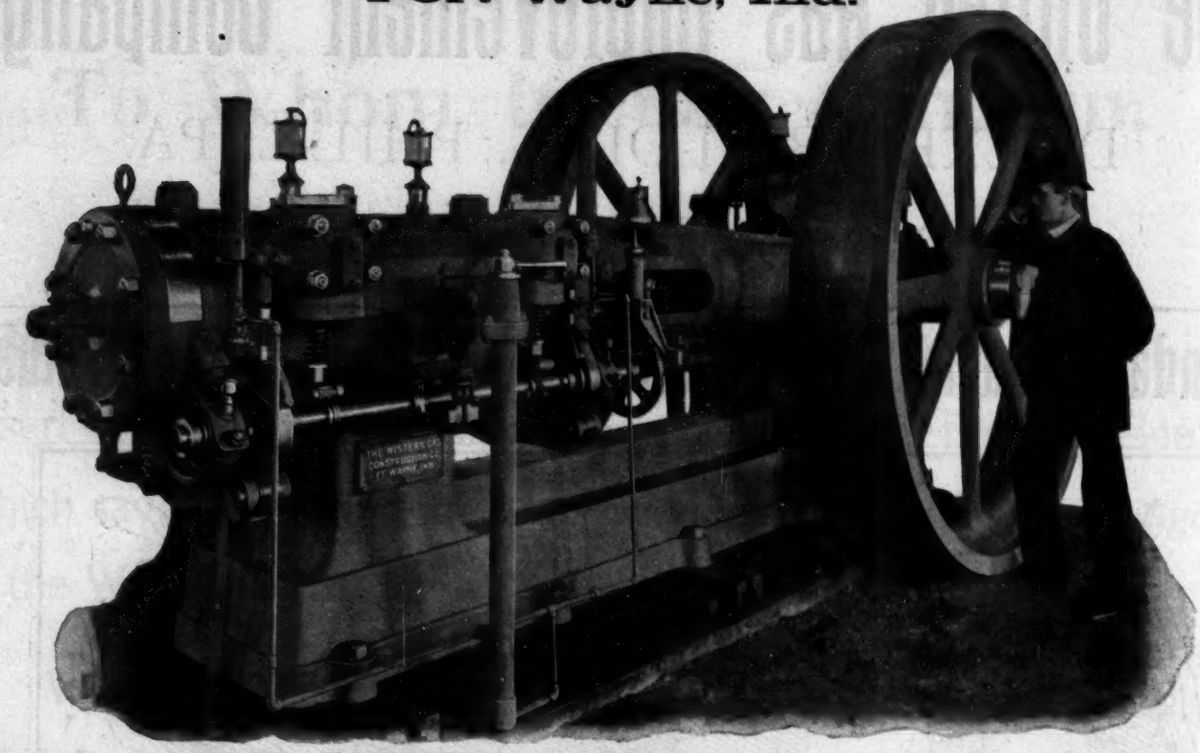
UPWARDS OF 215 SETS INSTALLED TO JANUARY 1, 1897.
ELEVEN PLANTS NOW IN PROCESS OF CONSTRUCTION.

Builders, Lessees and Purchasers of Gas Works.

Pamphlets, Plans and Estimates Furnished.

THE WESTERN GAS CONSTRUCTION CO.,

Fort Wayne, Ind.



The above illustrates the "AMERICAN KILMARNOCK" DOUBLE-ACTING GAS ENGINE, Electric Type, from 25 to 200 H.P., for Electric Light and Street Railway Duty. See Am. Gas Light Journal, May 17, page 767.

THE

LUDLOW VALVE MFG. CO.,

MANUFACTURERS OF

VALVES,

Double and Single Gate, ¼ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

SEND FOR CIRCULAR.

SEND FOR CIRCULAR.

ALSO,

Hydraulic Main Dip Regulators, Check Valves, Foot Valves, Yard Wash and Fire Hydrants.

OFFICE AND WORKS:
938 to 954 River St., & 67 to 83 Vail Av.
TROY N. Y.

NEW YORK MARINE PAINT CO.

Successors to TRACY & HADDEN.

TRADE MARK

MANUFACTURERS OF

PAINT PECULIARLY ADAPTED TO STAND ON Holders

And all Ironwork about Gas Works.

POUGHKEEPSIE, N. Y.

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

Works & Gen'l Office, Indian Orchard, Mass. Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston, Mass.
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,
70 Rush St., Near Division Ave., Brooklyn, N. Y.

The Gas Engineer's Laboratory Handbook.

By JOHN HORNBY, F.I.C.

Price, $2.50.

A. M. CALLENDER & CO., 22 Fine Street, N.Y. City

NATIONAL GAS AND WATER CO.,

218 La Salle Street, Chicago.

Builder and Operator of Gas Works.

The Rew Soft Coal Carbureted Water Gas Apparatus.

TESTED BY THREE YEARS' PRACTICAL OPERATION, AND FULLY GUARANTEED.

Plans and Estimates Upon Application.

IRWIN REW, President and Treasurer. E. E. MORRELL, Engineer.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR. OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT! WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION! REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE! IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 365 Canal St., New York.

Practical Photometry.

A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.

By William Joseph Dibdin.

Price, $3.00.

A. M. CALLENDER & CO.,

32 Pine Street, N. Y. City.

DOUGLAS' FERRIC OXIDE

For Gas Purification

Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

Full information, with references to many users, and prices delivered in any locality, furnished on application to

H.W. Douglas (Supt. Ann Arbor Gas Company) **Ann Arbor, Mich.**

IRON MASS

For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

JOHN SCHRIEVER, Manager.

Greenpoint Ave. & Newtown Creek, Brooklyn N.Y.

BOOKS.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR.

By George Lunge. Price $12.50.

TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS.

By David A. Graham. 8vo., Cloth. Price $3.

Orders for these books may be sent to this office.

A. M. CALLENDER & CO., Pine St., N. Y. City

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER.

FOR UTILIZING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER.

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial*. No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY

H. E. PARSON, Supt., 67 Bremen Street, Brooklyn, N. Y.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal.

Clinch Valley, Thacker & Logan Gas Coals

Old Kentucky Shale and O. K. Boghead.

Shipments from New York, Philadelphia, Baltimore and Norfolk.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

FIELD'S ANALYSIS

For the Year 1895.

An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland. Being the Twenty-seventh Year of Publication. Compiled and Arranged by

JOHN W. FIELD, Sec. & Gen. Mangr. of The Gas Lt. & Coke Co., London.

Price, $5. For Sale by

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

Coal Tar Genealogical Tree

MR. T. VINER CLARKE, of London, Eng., having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

in the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

GAS ENRICHERS. GAS COALS. GAS COALS.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, - - Clarksburgh, Harrison Co., West Va.
WHARVES, - - - Locust Point, Baltimore, Md.
OFFICE, - - - 44 South Street, Baltimore, Md.

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS, { BANGS & HORTON 60 Congress St., Boston.

ALTHOUSE & KENNEDY,

Reading Terminal—Philadelphia.

"Shaner," Westmoreland, Pa.

HIGH GRADE GAS COAL

AND

KENTUCKY CANNELS.

REPRESENTED BY

THOS. N. MORDUE, No. 1 Broadway, N Y

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

GREENOUGH'S "DIGEST OF GAS CASES."

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every gas company in the country, whether large or small. As a book of reference it will be found invaluable. It is the only work of the kind which has ever been published in this country, and is most complete. Handsomely bound. Orders may be sent to

A. M. CALLENDER & CO., 39 Pine St., N. Y.

— THE —

PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened and Prepared for Gas Purposes.

Their property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

Room 720, Reading Terminal Building, Phila., Pa.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River; Pier No. 1 (Lower Side), South Amboy, N. J.

EDMUND H. McCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.,
WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.,

Crude Oil, Gas Naphtha,
Refined Petroleum, Gas Oil.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.

RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES, FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK, Gas House and other Tile.

Office, 68 Van Dyke St., Brooklyn, N. Y.

Established 1854. Incorporated 1869.

LACLEDE Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . . FIRE BRICK . . . RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Exclusive Agents for

The Mitchell Half-Depth Regenerative Furnace.

This is the *original* coal-consuming Furnace for Retort Benches. Burns either Coal or Coke. Full and Half-Depth Regenerative Furnaces for Benches of 6's, 7's, 8's or 9's erected complete.

Proprietors of the Coze System of Inclined Retorts.

Office: 901 Pine St., **St. Louis, Mo.**

ESTABLISHED IN 1845.

B. KREISCHER & SONS,

Office, 119 E. 23d St., New York.

Gas Retorts,

TILES, FIRE BRICK.

AND EVERYTHING IN THE FIRE CLAY LINE.

Adam Weber,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

Works, LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR.,

Hamilton Building, Fifth Avenue, PITTSBURGH, PA. P. O. Box 373.

Successor to WILLIAM GARDNER & SON

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.

OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.

A cement of great value for patching retorts, putting on mouth-pieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

PRICE LIST.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD & CO.,

N. 3d & Prospect Avs., Mt. Vernon, N.Y.

Western Agent, H. T. GEROULD, Centralia, Ills.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,

417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec'y
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO

MANUFACTORY AT

LOCUST POINT BALTIMORE MD.

Clay Retorts, Blocks & Tile

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12x12x2 and 16x16x2.

WALDO BROS., 102 MILK ST., BOSTON, MASS.

Sole Agents for New England States.

PRACTICAL PHOTOMETRY.

A Guide to the Study of the Measurement of Light.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations Price, $3.00 A. M. CALLENDER & CO 32 Pine Street, N. Y. City

WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.

Single Cylinder.

Impulse Every Revolution.

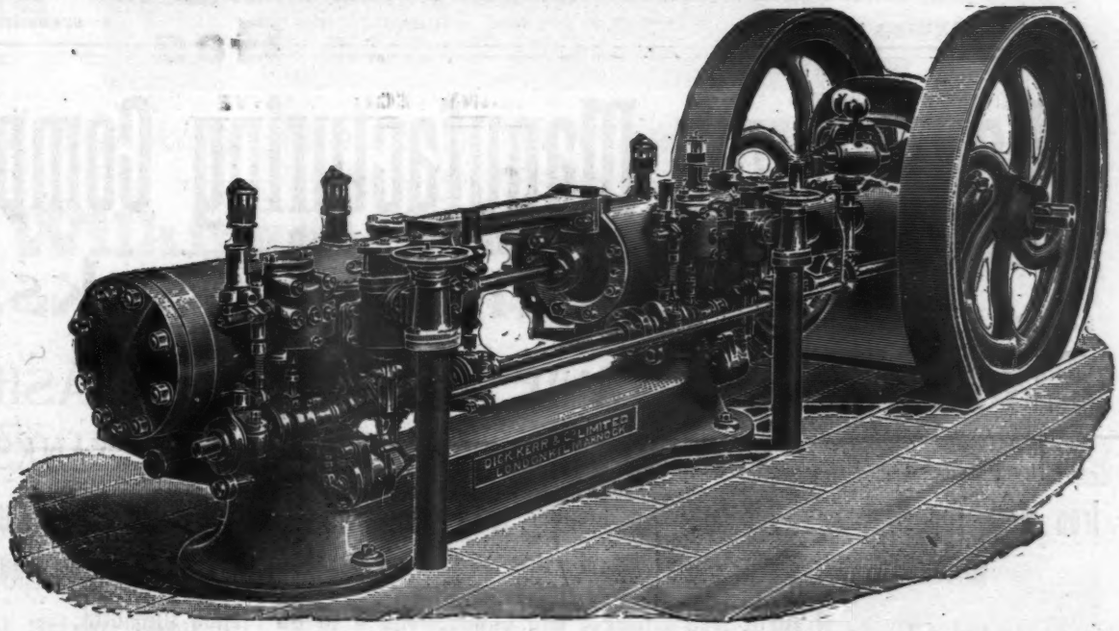
(Two Strokes.)

15 to 500 Horse Power

For General Work and Isolated Electric Plants.

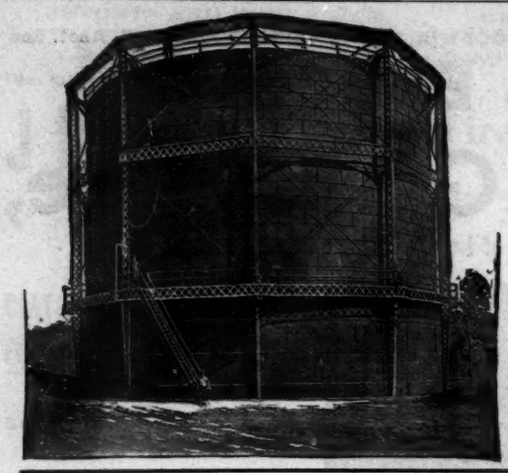
Tandem Cylinder. Impulse Every Stroke 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, 532 Bourse Building, Philadelphia Pa. or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts. Fort Wayne Ind.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

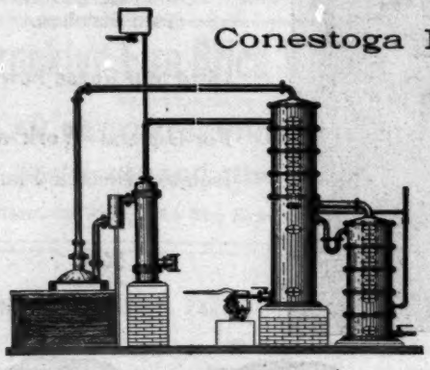
Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

GAS ENGINEERING COMPANY,

INCORPORATED,

Conestoga Building, PITTSBURGH, PA.



AMMONIA MACHINE.

MANUFACTURERS OF

Gas Works Machinery of all kinds,

PATENTEE AND OWNER OF

PITTSBURGH WASHER-SCRUBBER,

SOLE AGENT FOR

FELDMANN AMMONIA MACHINE,

For producing Sulphate, Aqua, Chloride and Concentrated Liquors.

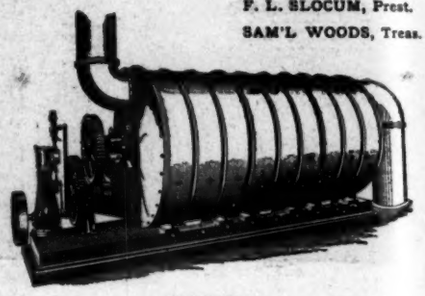
The Erection of Bi-Product Coke Ovens a Specialty.

Faux System of Recuperative Benches,

JAS. GARDNER, JR.
SOLE CONSTRUCTOR AND BUILDER.

NEW SYSTEM HYDRAULIC MAIN.

F. L. SLOCUM, Prest.
SAM'L WOODS, Treas.



SCRUBBER.

Kerr Murray Manufacturing Company,

Steel Gasholder Tanks,

SINGLE, DOUBLE AND TRIPLE-LIFT GASHOLDERS,

HORIZONTAL AND VERTICAL STORAGE OIL TANKS

Iron Work for Coal Gas Benches, Self-Sealing Mouthpieces, Exhausters, Condensers, Scrubbers, Purifiers, Wooden Trays, Floor Carriages, Center Seal and Valve System Connections, Cast and Wrought Iron Fittings, and Connections 3 to 36 Inches Diameter.

VALVES, Double Gate, Hub and Flange, Outside Screw and Quick Opening, 3 to 36 In. Diam.

COAL AND COKE WAGONS, RETORT-HOUSE TOOLS, STREET MAIN SPECIALS AND DRIPS.

Address,

KERR MURRAY MANUFACTURING CO.

Fort Wayne, Indiana.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double & Single-Lift

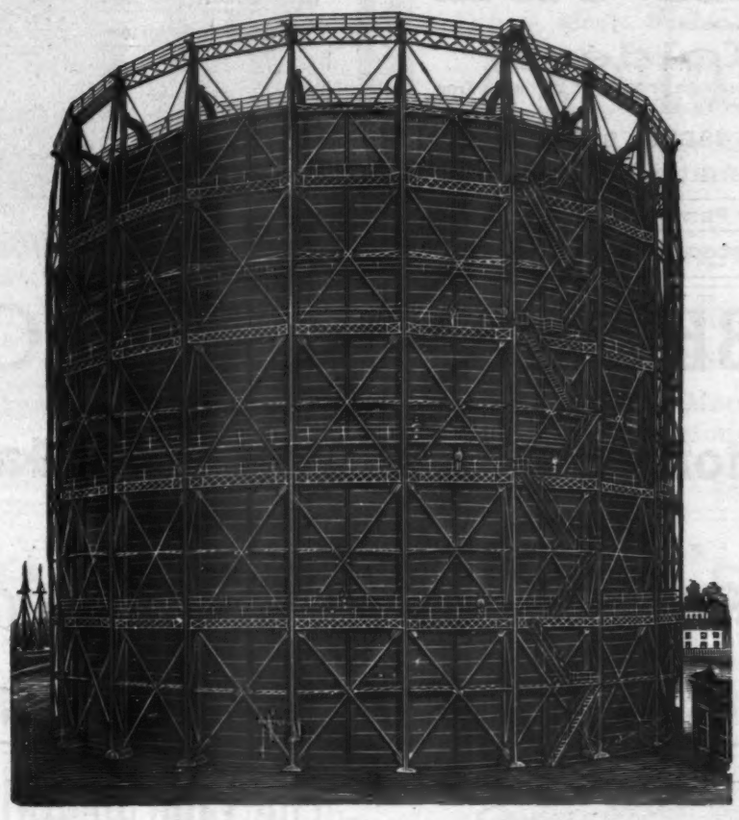
GASHOLDERS.

Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS



PURIFIERS.

CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS

Boilers.

Three Four-Lift Gasholders, each of 4,289,500 Cubic Feet Capacity, Erected in Chicago.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

W. H. PEARSON, President. J. T. WESTCOTT, Gen'l Mang'r & Treas. L. L. MERRIFIELD, Chief Engineer.

The Economical Gas Apparatus Construction Co., Ld.

269 Front Street, East, - - Toronto, Canada.

ENGINEERS AND BUILDERS

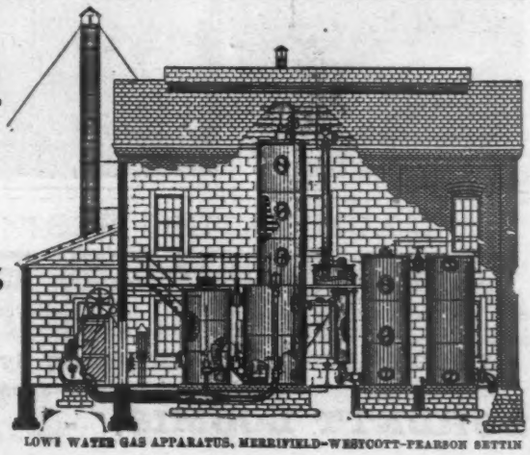
OF THE

Improved Lowe Water Gas Apparatus

Designed to give the Greatest Efficiency when using any kind of Oil, Anthracite Coal, Gas House or Oven Coke.

New Gas Works Built, Present Gas Plants, either Coal or Water, Remodeled

Catalogues, Plans and Estimates Furnished upon Application.



LOWE WATER GAS APPARATUS, MERRIFIELD-WESTCOTT-PEARSON SETTIN

R. D. WOOD & CO.,

ENGINEERS, IRON FOUNDERS, MACHINISTS.

400 Chestnut Street, Philadelphia, Pa.

MANUFACTURERS OF

CAST IRON PIPE.

BUILDERS OF

Gas Holders,

Single, Double and Triple Lifts, with or without Wrought Iron or Steel Tanks.

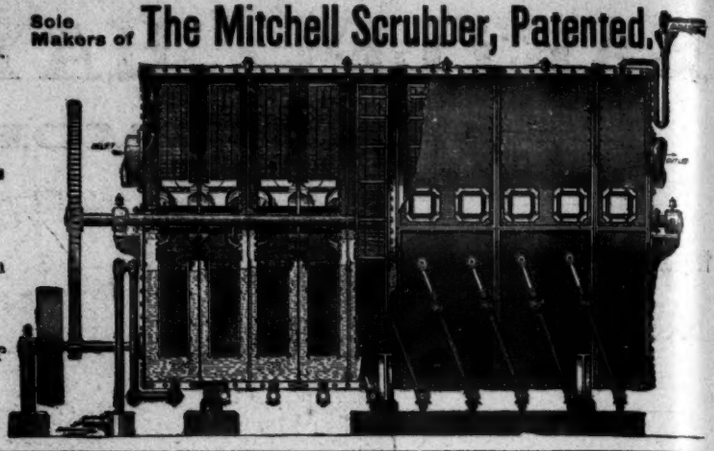
PURIFIERS, CONDENSERS, SCRUBBERS.

The Hopper Automatic Gas Governor

Send for Pamphlet.

Dunham Patent Specials.

Sole Makers of **The Mitchell Scrubber, Patented.**



ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

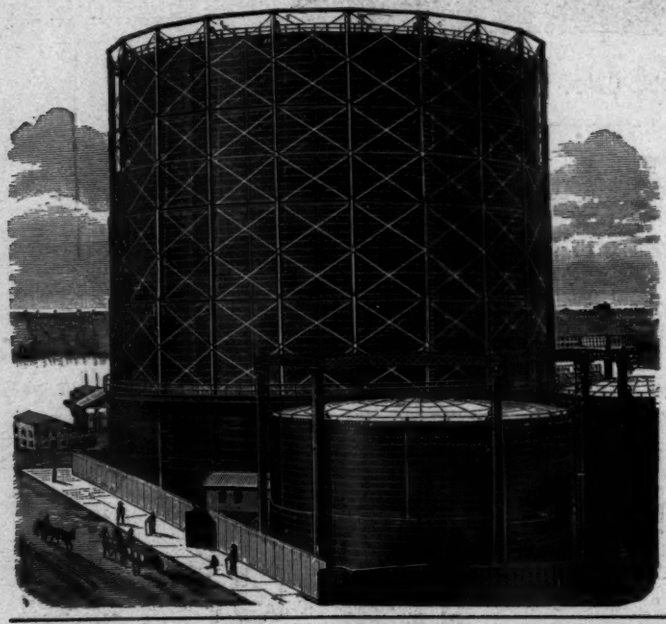
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. OFFICES **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM N. Y. TO GREENPOINT.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gas Holder Tanks.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers
Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

BURDETT LOOMIS, - - Hartford, Conn.

To Gas Companies.

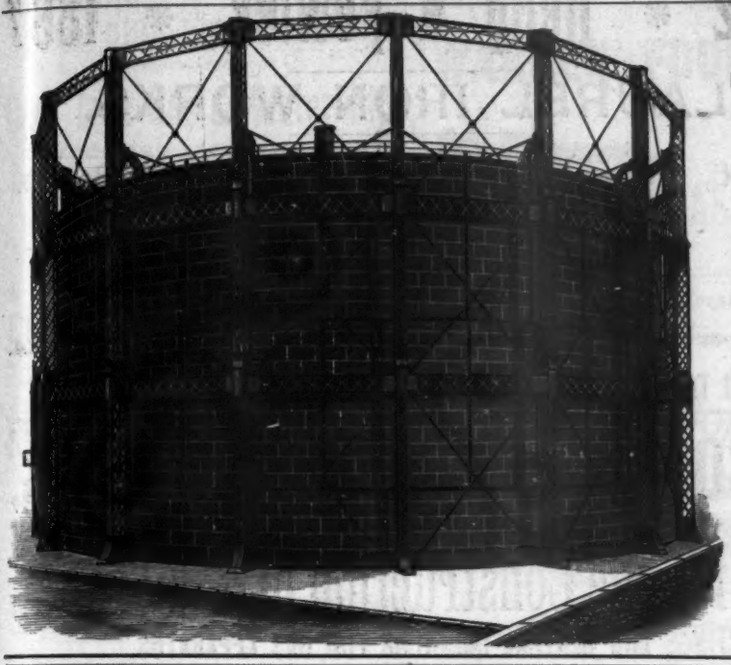
We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER.

245 N. 8th St., Phila., Pa.

GAS WORKS APPARATUS AND CONSTRUCTION. GAS WORKS APPARATUS AND CONSTRUCTION.



H. HANSHAW, Prest. & Mangr. T. H. BIRCH, Asst. Mangr
WILLIAM STACEY, Vice-Prest. R. J. TARVIN, Sec. & Treas.

THE STACEY MANUFACTURING CO
Established 1851.

Single, Double and Triple-Lift

GASHOLDERS,

Of any Capacity, with or without Wrought Iron or Steel Tanks.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, etc.

Coal Gas Benches, Roof Frames,

OIL STORAGE TANKS.

Pressed Steel Mouthpiece Lids, Self-Sealing Mouthpiece Lids.

Cincinnati, Ohio.

George Shepard Page's Sons,

Sole Agents for

The Ammonia Washer-Scrubber.

The Walker Tar and Carbonic Acid Extractor, The Walker Sulphate and Ammonia Still.
The Walker Self-Sealing Pressed Steel Mouthpiece Lids.

The Berlin Center Valve. And Contractors for Ammoniacal Liquor.

No. 69 Wall Street, New York City.

Practical Hints
ON THE CONSTRUCTION AND WORKING OF
Regenerator Furnaces,
By MAURICE GRAHAM, C.E.
Price, $1.25.
A. M. CALLENDER & CO., 32 Pine Street, N. Y.

GEORGE R. ROWLAND.
Formerly with the Continental Iron Works.
Draughtsman and Constructing Engineer.
Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.
Office, No. 245 Broadway, N. Y. City.

T. G. LANSDEN,
Consulting and Contracting Gas Engineer
Estimates, Plans and Specifications for New Works (Coal or Water Gas), and for Extensions or Alterations.
Room H, 108 N. 4th St., St. Louis, Mo.

WM. HENRY WHITE,

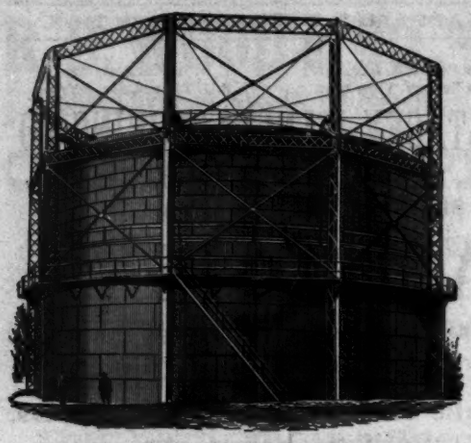
No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.
Plans and Estimates Furnished.



1842 * Deily & Fowler, * 1897

LAUREL IRON WORKS.

Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.

JAMES R. FLOYD & SONS,

Successors to HERRING & FLOYD,

Oregon Iron Works,

West 20th and 21st Streets, Between 10th & 11th Avenues, New York City.

Engineers and Contractors for the Construction of Gas Works.

MANUFACTURERS OF ALL KINDS OF CASTINGS AND GENERAL IRONWORK FOR GAS APPARATUS.

Bench Castings, Regenerative and Half Regenerative Furnace Castings, Condensers, Tower Scrubbers, Mechanical Scrubbers, Purifiers, Malleable Iron Retort Lids, Self-Sealing Retort Lids, Hydraulic Hoist Purifier Carriage, Crosses, Tees, Bends, Angles, Reducers, S-Bends, Sectional Sleeves, Plugs, Caps, Street Drips, etc., always on hand.

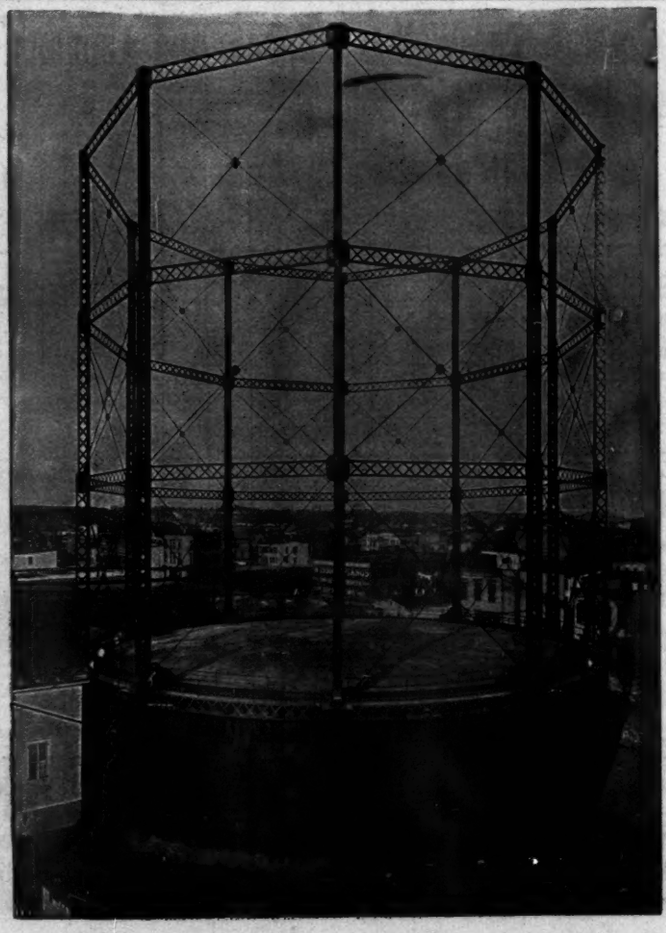
WOOD'S GAS SCRUBBING AND ENRICHING APPARATUS.

In use at Syracuse, Auburn, Watertown, Cortland and Geneva, N.Y.; Elizabeth, N. J.; Boston, Mass.; Jamaica Plain, Mass.; Providence, R. I.; Northern Liberties Gas Co., Phila.

Sole Manufacturers of the OGDEN QUICK-MOVING VALVE.

HEARNE CENTER SEAL, Operating One, Two, Three or Four Boxes.

Stroh & Osius Concentrator for Ammoniacal Liquor, used by 50 Gas Companies and Cokeries during the past 4 years.



The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu. Ft.

LOGAN IRON WORKS,

Brooklyn, N. Y.

MANUFACTURERS OF

Single or Multiple-Lift

GASHOLDERS,

Complete with Steel Tanks.

BENCHES, SCRUBBERS,

CONDENSERS,

PURIFIERS, IRON ROOFS,

Self-Sealing Retort Lids,

AND ALL PARTS OF

GAS WORKS APPARATUS

Contractors for Complete Works.

ALSO, SOLE MANUFACTURERS OF

C. W. BLODGET'S

HOT GAS SCRUBBER.

GAS AND WATER PIPES.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

Cast Iron Gas & Water Pipe,

BRANCH AND SPECIAL CASTINGS.

Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

GENERAL FOUNDERS AND MACHINISTS

Columbus, Ohio.

DAVID LEAVITT HOUGH,

26 CORTLANDT ST., N.Y. CITY.

Consulting Engineer.

Investigations and Appraisals.
Designs and Estimates.

Contractor.

Machinery and Structures.
Gas and Water Pipe.

Special Agent for Selling & Purchasing.

GAS METERS.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches. Bends, Retorts, etc., etc

GEORGE ORMROD, Manger. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

1894 DIRECTORY 1894

OF AMERICAN GAS COMPANIES

Price, - - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

SCIENTIFIC BOOKS.

GAS MANUFACTURE, by William Richards. 4to., with numerous Engravings and Plates, in Cloth binding. $12.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards, C.E. 20 cents.

PRACTICAL TREATISE ON HEAT AND VENTILATION, with Special Relation to Illuminating, Heating and Cooking by Gas. By E. E. Perkins. $1.25.

CHEMISTRY OF ILLUMINATING GAS. By Norton H. Humphrys. $2.40.

PRACTICAL TREATISE ON HEAT By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

GAS WORKS: Their Arrangement, Construction, Plant and Machinery. $5.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfield. $1.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL, SPONTANEOUS COMBUSTION OF. By Thomas Rowan, C.E. $2.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

THE GAS WORKS OF LONDON. By Colburn. 60 cents.

HEAT A MODE OF MOTION. By John Tyndall $..

THE MANAGEMENT OF SMALL GAS WORKS. By C. J. R. Humphreys. $1.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

GASFITTER'S GUIDE, by John Eldridge 40 cents.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2

CONSTRUCTION OF GAS WORKS, by Walter Ralph Herring. $2.

DIGEST OF GAS CASES. $5.

PRACTICAL HINTS ON REGENERATOR FURNACES By M. Graham. $1.25.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR. By Geo. Lunge. New edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5.

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby, F.I.C. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

GAS MANUFACTURE, THE CHEMISTRY OF, by W. J. A. Butterfield. $3.50.

AMERICAN PLUMBING. By Alfred Bevill. $2.

CEMENT: A Manual of Lime and Cement, their Treatmen and Use in Construction. By A. H. Heath. $2.50.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Knapp. $3.50.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

MAGNETISM AND ELECTRICITY. By J. Overend. 40 c

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHTING, by Francis B. Crocker, E.M. $3.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRICITY, Its Theory, Sources and Applications. By John T. Sprague, M.I.E.E. $6.

The above will be forwarded upon receipt of price. If sent by mail or express, postage or express charges must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order. No books sent C.O.D.

A. M. CALLENDER & CO., 32 Pine Street, New York.

NATHANIEL TUFTS METER CO.,

63 Beverly Street, Boston, Mass.

MANUFACTURERS OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Apparatus for the Chemical Testing of Gas and Gas Liquor.

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 107 West Monroe St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**
BOSTON, 92 Water Street, Rooms 21 and 22.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Perfect" Gas Stoves

METRIC METAL COMPANY,

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

"Good Advice, if taken in Season,"
will Save Much Vexation and Many Dollars.

USE KEYSTONE METERS

THIS SPRING.

THE KEYSTONE METER CO., ROYERSFORD, PA.

GAS METERS. GAS METERS. GAS METERS.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

Manufactories:
512 West 22d St., N. Y.
Arch & 22d Sts., Phila.

GAS STOVES.
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters with Lizar's "Invariable Measuring" Drum.

Agencies:
125 & 127 S. Clinton Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

HELME & McILHENNY,

Established 1848. 1339 to 1349 Cherry Street, Philadelphia, Pa.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.

D. McDONALD & CO.,

Established 1854.

511 West 21st Street, NEW YORK CITY.
51, 53 & 55 Lancaster St., ALBANY, N. Y.
34 & 36 W. Monroe St., CHICAGO, ILL.

MANUFACTURERS OF

Wet and Dry Gas Meters

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS & PRESSURE GAUGES.

Meters of all makers Thoroughly Repaired.

THEODORE D. BUHL, President. CHARLES H. JACOBS, Vice-President and Managing Director

BUHL STAMPING CO. TRADE MARK RELIABLE GAS METERS DETROIT, MICH. U.S.A.

Buhl Stamping Company,

Detroit, Mich.

Manufacturers of Gas Meters of the Highest Quality.

METER REPAIRING A SPECIALTY. SEND FOR OUR PRICE LIST.

Detroit is one of the best shipping points in the United States for prompt deliveries by rail or water to the East, West or South.

BUHL Meters will need few Repairs. We make our own Tin Plate. Trial Orders Solicited.

The Advertisement of the

OTTO GAS ENGINE WORKS,

33d and Walnut Streets, Philadelphia,

New York, 18 Vesey St. Boston, 19 Pearl St., Chicago, 245 Lake St.,

Occupies this space every alternate week.

JOHN J. GRIFFIN & CO.,

1513-1515-1517-1519-1521 Race Street, Philadelphia.

52 Dey Street, New York. WM. S. GRIBBEL, Manager. | **75 N. Clinton St., Chicago.** FREDERICK WAUGH, Manager.

MANUFACTURERS OF

STATION METERS, CONSUMERS' METERS,

Provers, Registers, Gauges, Experimental Apparatus, Etc.

Prompt Attention Given to All Repairing.

OUR SPECIAL NATURAL GAS METER

Is the Best ever offered. Over 30,000 now in use.

We manufacture in the United States, under the SAWER & PURVES PATENTS, the

Positive Prepayment Meter.

. . SIMPLE . .

. DURABLE .

. ACCURATE .

. RELIABLE .

All Parts Interchangeable

This Meter is an unqualified success in Great Britain. Its simplicity of construction, and the positive character of the service performed by it, have given it pre-eminence.

Needs Only the Care Given an Ordinary Meter.

Saves MONEY, TIME and CONSUMERS.

Dispenses with "DEPOSITS" and Increases OUTPUT.